Office of Science

Pollution Prevention UPDATE 1993 - 1998

March 2000

Prepared by the Office of Laboratory Operations
& Environment, Safety, & Health (SC-80)

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LIST OF ACRONYMS USED

ANL-E .... **Argonne National Laboratory-East**
APRS .... **Affirmative Procurement Reporting System**
BNL .... **Brookhaven National Laboratory**
CY .... **Calendar Year**
DOE .... **Department of Energy**
EO .... **Executive Order**
EPA .... **U.S. Environmental Protection Agency**
ES&H .... **Environment, Safety, and Health**
ESH&I .... **Environment, Safety, Health, and Infrastructure**
FY .... **Fiscal Year**
GSA .... **General Services Administration**
HLW .... **High-Level Waste**
LBNL .... **Lawrence Berkeley National Laboratory**
LLRI .... **Lovelace Respiratory Research Institute**
LLW .... **Low-Level Waste**
MLLW .... **Mixed Low-Level Waste**
MTRU .... **Mixed Transuranic Waste**
OMB .... **Office of Management and Budget**
ORNL .... **Oak Ridge National Laboratory**
PNNL .... **Pacific Northwest National Laboratory**
PSO .... **Program Secretarial Office**
RCRA .... **Resource Conservation and Recovery Act**
SC .... **Office of Science**
SLAC .... **Stanford Linear Accelerator Facility**
TJNAF .... **Thomas Jefferson National Accelerator Facility**
TRI .... **Toxics Release Inventory**
TRU .... **Transuranic Waste**
TSCA .... **Toxic Substances Control Act**

1.0 Introduction

This document is the fifth in a series of updates on Office of Science (SC) pollution prevention activities. It provides the latest information available on waste generation and waste minimization activities, dollars spent purchasing designated goods containing recycled materials, and toxic release reductions. This update contains the following information:

- Waste Generation Trends from 1993 through 1998
- Affirmative Procurement Accomplishments in 1998
- Toxic Release Inventory Trends from 1993 through 1998
- Pollution Prevention Funding from the Environment, Safety, Health and Infrastructure (ESH&I) Five-Year Plan for FY 2000 through FY 2005
- 1998 Pollution Prevention and Waste Minimization Accomplishments (See Appendix A)

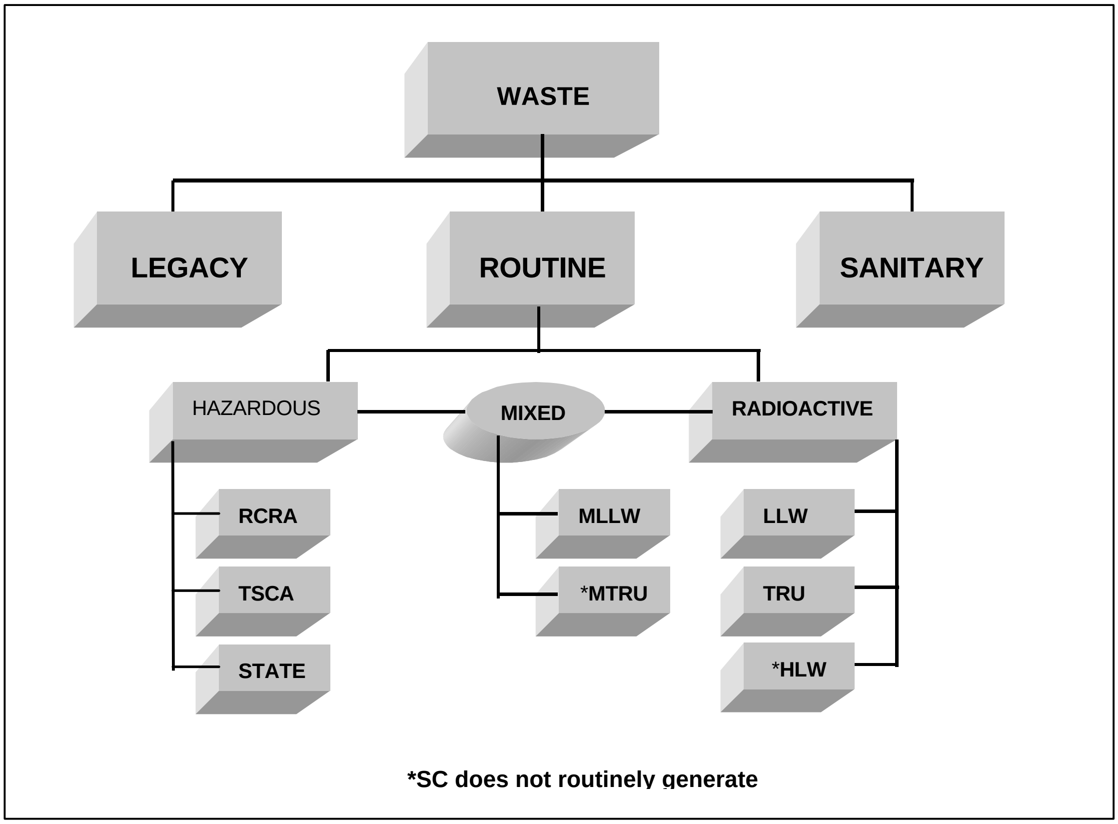
2.0 Waste Generation Data

This update is based on waste generation data from the latest Department of Energy (DOE) Environmental Management (EM) *Annual Report of Waste Generation and Pollution Prevention Progress* of September 1999. Since 1993, this series of annual reports has distinguished wastes generated by environmental restoration/clean-up activities (i.e., "legacy" wastes) from wastes generated by operations (i.e., routine or "newly generated" wastes). The scope of this document is limited to SC's routine wastes, which are generated from operations, and are not associated with "legacy wastes."

The Annual Reports list the quantities of wastes generated which are regulated under the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA) and various state regulations. The sum of these three types of waste are reported collectively as Total Hazardous Wastes. The Annual Reports also list quantities of low-level radioactive waste (LLW), high-level wastes (HLW), transuranic wastes (TRU), mixed low-level wastes (MLLW) and mixed transuranic wastes (MTRU). SC does not routinely generate high-level or MTRU wastes, so for the purposes of this update, Total Radioactive Wastes are the sum of LLW, MLLW and TRU. Sanitary wastes are included in the EM Annual Reports; therefore this update provides a summary of routine sanitary waste generation by SC as a whole, and a summary of all sanitary waste generated by SC and others at SC laboratories. Figure 1 (Page 2) presents the types of wastes generated by SC and DOE Program Secretarial Offices (PSOs).

This report employs certain simplifying assumptions made in the EM Annual Reports. To enable quick comparison of quantities of radioactive wastes reported in cubic meters with quantities of hazardous wastes reported in metric tons, it is assumed that one cubic meter of waste equals one metric ton. This conversion factor is a gross approximation. An accurate conversion factor for radioactive waste depends on the physical state of the waste (liquid or solid), its composition, (lead, Styrofoam, etc.), and its degree of compaction, and would have to be calculated for each wastestream. In addition, waste reporting methods vary among

Figure 1 Types of Waste Generated



different laboratories. Some wastes reported as generated in a given year may have been generated previously, but were shipped for disposal during the year in question.

DOE sites reported their waste generation in the Annual Reports if quantities of any one type of waste exceeded any one of the following thresholds:

- 50 cubic meters of low-level waste
- 1 cubic meter of mixed waste
- 10 metric tons of RCRA-regulated waste
- 10 metric tons of TSCA-regulated waste

Sites with waste generation levels below these thresholds were not required to participate in the EM annual waste reporting process, but only had to report their waste generation in an attachment to their EM Exemption Request Memo. From 1994 to 1997, Ames Laboratory, Oak Ridge Institute for Science Education, and the Thomas Jefferson National Accelerator Facility reported their waste generation in an EM Exemption Request Memo because their waste generation fell below the reporting threshold. In 1998, all of these sites reported their waste generation to EM.

2.1 DOE-Wide Pollution Prevention Goals

DOE tracks and reports the quantities of waste it generates, because it is committed to specific waste reduction goals. In 1996, the Secretary of Energy set the following pollution prevention goals to be achieved by December 31, 1999. Waste generation levels in 1993 are used as the baseline for comparison.

- Reduce generation of routine radioactive waste by 50 percent.
- Reduce generation of routine MLLW by 50 percent.
- Reduce the generation of routine hazardous waste by 50 percent.
- Reduce the generation of sanitary waste by 33 percent.

Other pollution prevention goals to be achieved by this date include:

- Recycle 33 percent of sanitary wastes.
- Increase procurement of EPA-designated recycled products to 100 percent.

On November 12, 1999, the Secretary of Energy renewed and expanded these goals. Using the same 1993 baseline, DOE has committed to the following reductions in routine waste generation by 2005:

- Reduce generation of routine hazardous waste by 90 percent.
- Reduce generation of low-level wastes by 80 percent.
- Reduce low level mixed wastes by 80 percent.
- Reduce transuranic wastes by 80 percent.
- Reduce of toxic chemical inventory (TRI) releases by 90 percent.
- Reduce sanitary wastes by 75 percent by 2005—then achieve an 80 percent reduction by 2010.

1998 Pollution Prevention Highlights

Waste Type	***1998 Reduction***	***1999 Goal***	***2005 Goal***
Total Hazardous Wastes	-66%	-50%	-90%
State Wastes	-72%	-50%	-90%
RCRA Wastes	-44%	-50%	-90%
TSCA Wastes	-86%	-50%	-90%
Total Radioactive Wastes	-55%	-50%	-80%
Low Level Wastes	-55%	-50%	-80%
Mixed Low Level Wastes	-63%	-50%	-80%
Sanitary Wastes	-48%	-33%	-75%

The Secretary of Energy set additional pollution prevention goals:

- Recycle 45 percent of sanitary wastes by 2005 and 50 percent by 2010.
- Increase purchases of EPA-designated items with recycled content to 100 percent, except when not available at competitive price or when they do not meet performance standards.

The pollution prevention goals apply to DOE as a whole, not to PSOs or individual generators. However, measuring SC waste reduction against these goals is a useful measure of commitment to them.

2.2 SC Reporting Sites

Twelve sites under SC management reported waste generation from 1993 to 1998. Another five sites with SC activities reported waste generation. Totals for SC waste generation are the sums of SC wastes generated at all 17 of these sites. SC routine wastes are compared to routine wastes generated by all other PSOs (Environmental Management, Defense Programs, etc). Table 1 lists the sites included in this update.

Table 1: List of Sites Included in this Update	
Sites under SC Management	
Accelerator Facilities:	Fermi National Accelerator Facility (Fermi) Stanford Linear Accelerator Facility (SLAC) Thomas Jefferson National Accelerator Facility (TJNAF)
Multi-program Sites:	Argonne National Laboratory-East (ANL-E)* Brookhaven National Laboratory (BNL) Lawrence Berkeley National Laboratory (LBNL) Oak Ridge National Laboratory (ORNL) Pacific Northwest National Laboratory (PNNL)
Small Laboratories:	Ames Laboratory (Ames) Princeton Plasma Physics Laboratory (PPPL)
Other DOE Sites with SC Activities	
Lawrence Livermore National Laboratory (LLNL) Los Alamos National Laboratory (LANL) Lovelace Respiratory Research Institute (LRRI) *(formerly Inhalation Toxicology Research Institute (ITRI))* Office of Science and Technical Information (OSTI) Sandia National Laboratory-California (SNL-CA) Sandia National Laboratory-New Mexico (SNL-NM)	
Other DOE Sites without SC Waste	
Bonneville Power Administration (Bonnv.) Fernald Area Office Hanford Reservation Idaho National Engineering and Environmental Laboratory (INEEL) East Tennessee Technology Park (ETTP) (formerly K-25) Pantex Site Portsmouth Site Office (Ports.) Savannah River Site (SRS) West Valley Demonstration Project (WVDP) Y-12 Site at Oak Ridge	
Non-DOE Sites under SC Management	
Oak Ridge Institute for Science and Education (ORISE)	

*Wastes from the New Brunswick Laboratory are included in ANL-E's 1998 figures.

2.3 Summary of Annual Report Data

Figure 2 presents the sum of SC's total routine waste generation (hazardous and radioactive wastes) from 1993 to 1998. Table 2 shows the types of quantities of routine wastes that SC generated during this period.

Figure 2

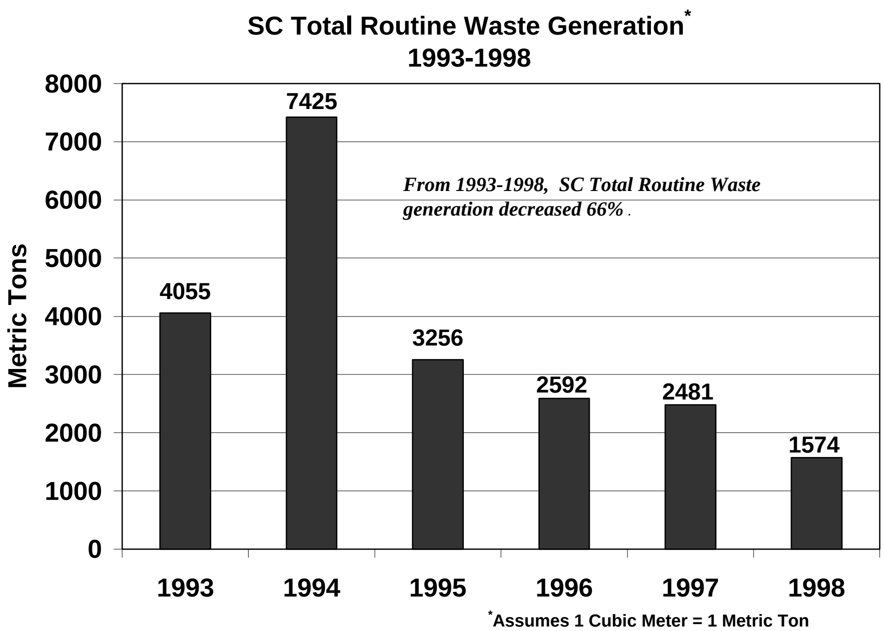


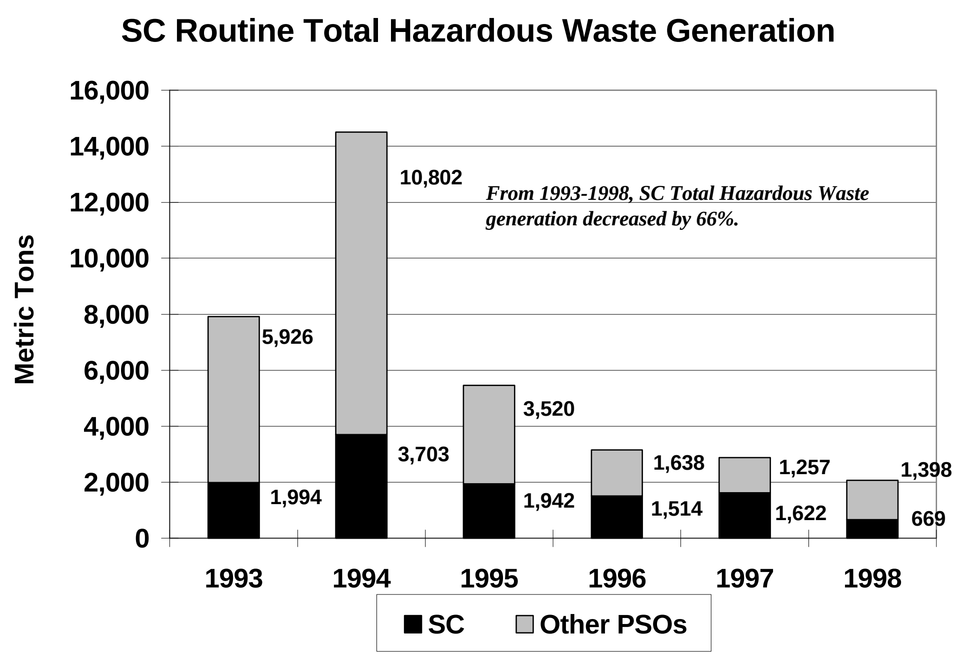
Table 2: SC Routine Waste Generation, 1993-1998								
	Hazardous Wastes (Metric Tons)				**Radioactive Wastes (Cubic Meters)**			
	RCRA	*State*	*TSCA*	*Total Hazardous*	*LLW*	*MLLW*	*TRU*	*Total Radioactive*
1993	437	1,535	22	1,994	1,947	114*	0	2,061
1994	248	2,596	859	3,703	3,626	96	0	3,722
1995	229	1,463	250	1,942	1,263	51	0	1,314
1996	201	1,295	18	1,514	1,053	25	0	1,078
1997	171	1,446	5	1,622	819	40	0	859
1998	243	423	3	669	868	33	4	905

* Revised downward to 89.02 cubic meters upon review of records at LBNL. Section 2.5.2 of this report cites the uninflated figure.

2.4 Hazardous Waste Generation

Routine hazardous wastes consist of RCRA, TSCA, and state-regulated wastes. Trends for routine hazardous waste generation are presented in Figure 3. In 1998, SC Total Hazardous Waste generation was 66 percent lower than the 1993 baseline. Much of this decrease occurred in 1998, when hazardous waste generation declined by 66 percent. A dramatic drop in generation of state-regulated wastes at ANL-E is the primary cause of this decline. As seen in Table 2 (Page 5), state-regulated wastes continue to be the largest component of SC hazardous wastes. In 1998, SC generated 32 percent of the DOE routine hazardous waste stream, down from 56 percent in 1997.

Figure 3



2.4.1 State-Regulated Wastes

State-regulated wastes are hazardous wastes which are not regulated under RCRA, but which are listed as hazardous and are subject to regulation by states or other local authorities. The Environmental Protection Agency does not necessarily consider them hazardous. Figure 4 (Page 7) shows SC's generation of routine state-regulated wastes for the given period. From 1997 to 1998, SC's state-regulated waste generation decreased by 72 percent. State-regulated wastes have made up nearly 90 percent of SC 's hazardous wastes from 1995 to 1998. Trends for generation of state-regulated wastes at individual laboratories are presented in Figure 5 (Page 7).

Figure 4

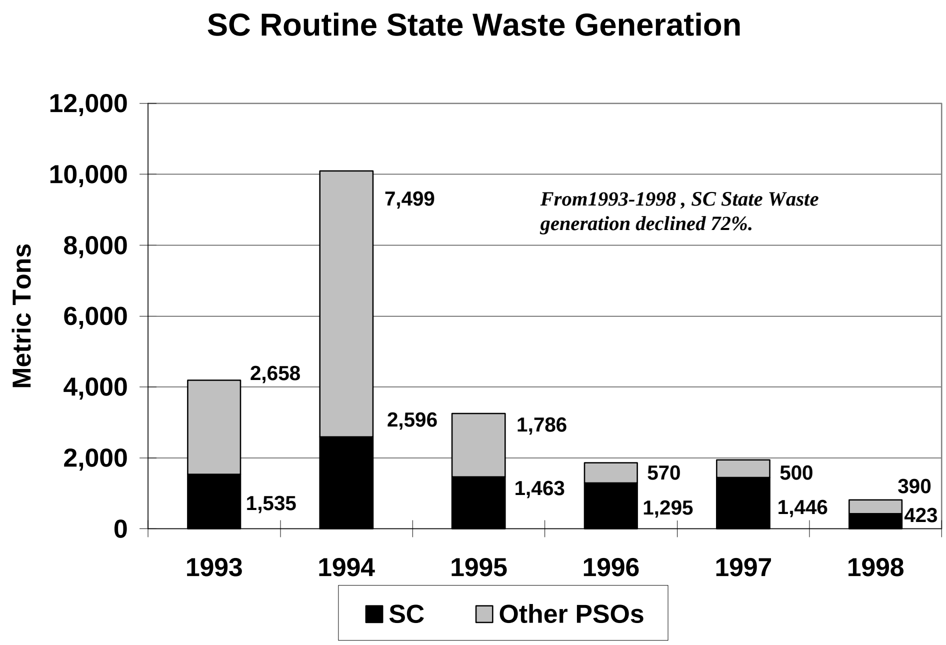
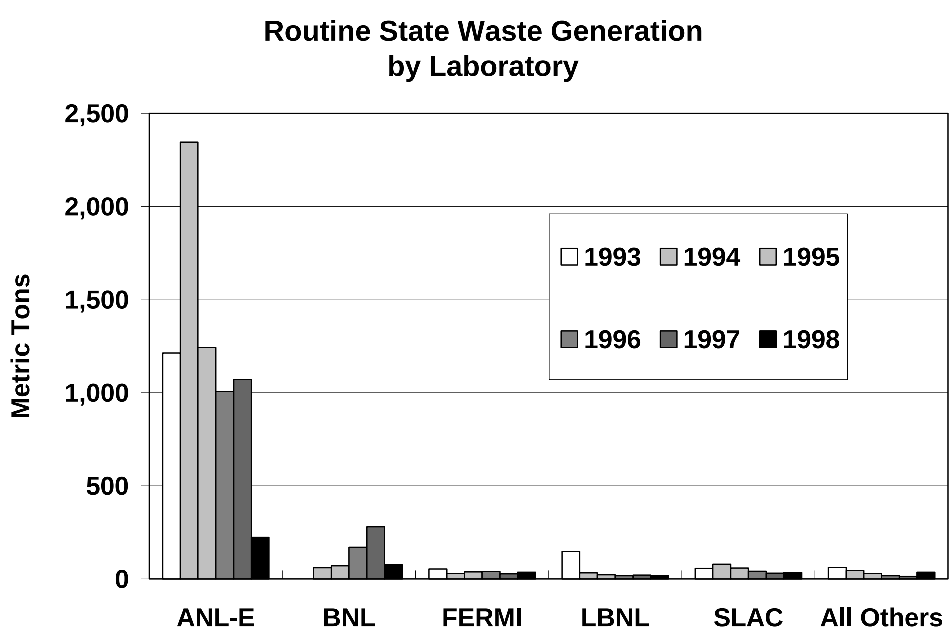


Figure 5



Percent Change in SC State Waste Generation from 1993-1998					
ANL-E	**BNL**	**Fermi**	**LBNL**	**SLAC**	**All Others**
-82%	**N/A**	**-33%**	**-80%**	**-40%**	**-42%**

Table 3 shows the states that regulate non-RCRA hazardous wastes at SC sites. In previous years, ANL-E was subject to Illinois waste regulations, which classified coal fines from the central steam plant as state-regulated wastes. These regulations made ANL-E the single largest generator of state-regulated wastes in SC, and made SC the single largest generator of state wastes in DOE. In 1998, Illinois regulations stopped classifying coal fines as state-regulated wastes, which allowed ANL-E to dispose of them as ordinary municipal waste. This one regulatory change is responsible for the dramatic decline in state-regulated wastes in SC during 1998. ANL-E's aggressive measures to recycle its coal fines have kept these former state-regulated wastes out of the sanitary wastestream.

BNL, SC's second-largest generator of state-regulated wastes, also experienced a 73 percent decline in these wastes from 1997 to 1998.

Table 3: State-Regulated Hazardous Wastes at SC Facilities (Metric Tons)

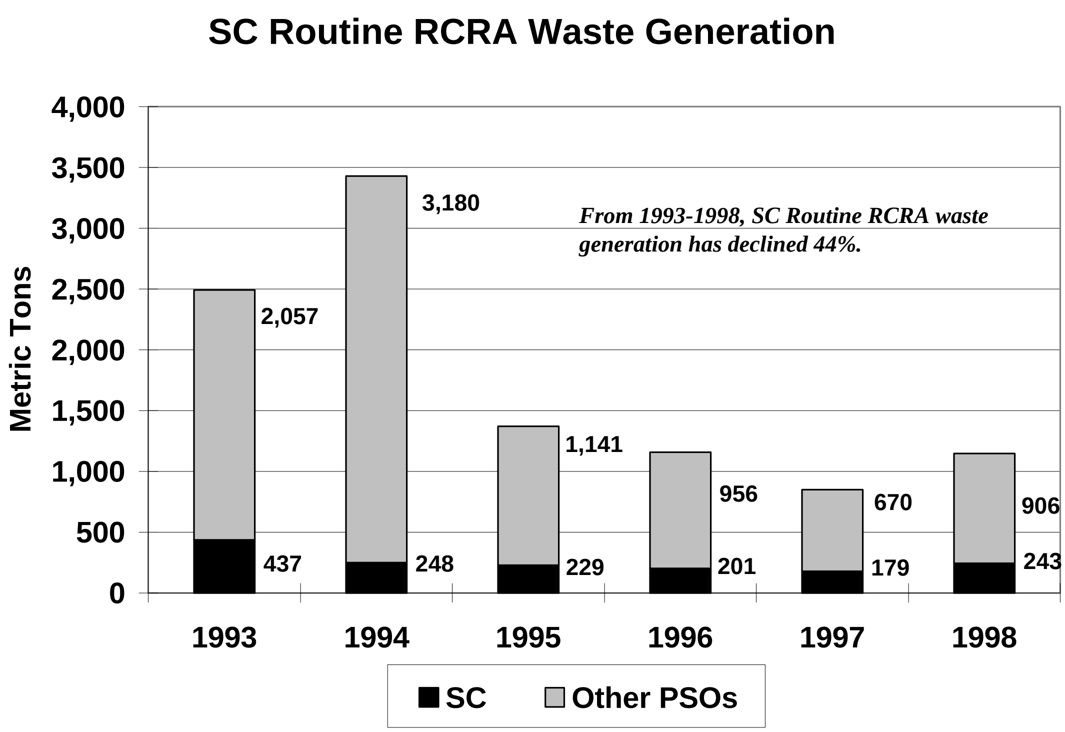
State	Labs	1993	1994	1995	1996	1997	1998
CA	LBNL, LLNL, Sandia/CA, SLAC	232	138	91	64	54	53
IL	ANL-E, Fermi	1,268	2,377	1,282	1,048	1,099	260
NY	BNL	N/A	60	70	171	281	75
Others:* **(IA, NJ, NM, VA, WA)**	Ames, LRRI, PNNL, PPPL, Sandia/NM, TJNAF	35	21	20	12	12	35
	Totals:	**1,535**	**2,596**	**1,463**	**1,295**	**1,446**	**423**

*The State of Tennessee (ORISE, ORNL) does not add its own hazardous waste regulations to existing Federal regulations.

2.4.2 RCRA Wastes

RCRA wastes are solid wastes that are either listed hazardous wastes or wastes, which exhibit the characteristics of a hazardous waste according to 40 CFR 261. Figure 6 (Page 9) presents SC routine RCRA waste generation from 1993 to 1998. Total SC quantities declined by 44 percent relative to the 1993 baseline. SC's relative contribution to the DOE RCRA waste stream has been steadily rising as total quantities decline. SC contributed 7 percent of DOE's routine RCRA wastes in 1994, 17 percent in 1995 and 1996, 20 percent in 1997, and 27 percent in 1998.

Figure 6

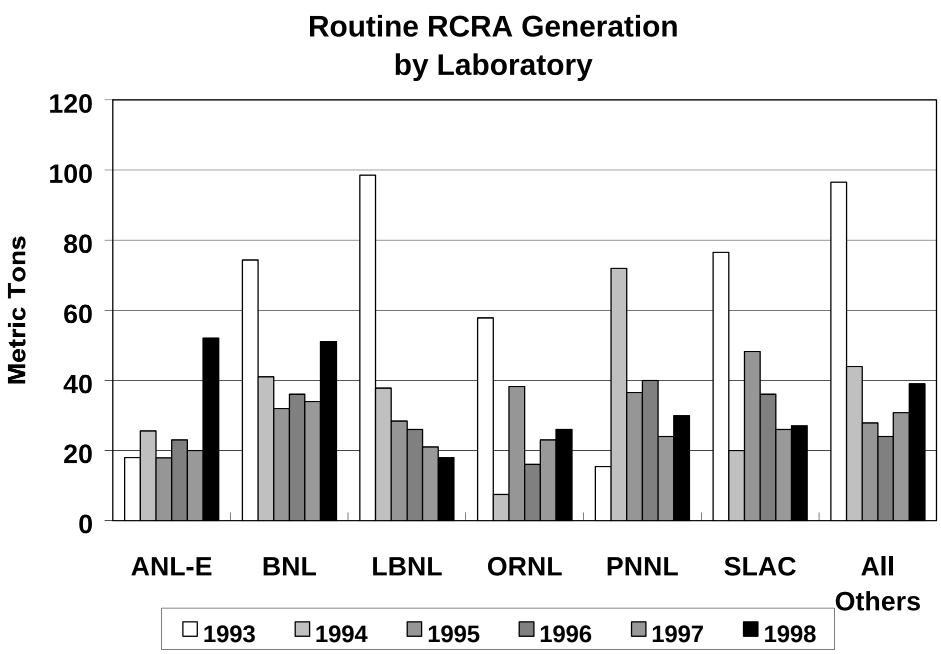


Percent Change in SC RCRA Waste Generation from 1993-1998						
ANL-E	**BNL**	**LBNL**	**ORNL**	**PNNL**	**SLAC**	**All Others**
+190%	**-31%**	**-82%**	**-55%**	**+90%**	**-65%**	**-60%**

Figure 7 (Page 10) shows RCRA generation trends in SC laboratories. Six laboratories were responsible for 75 percent of SC's RCRA waste generation from 1993 to 1997: ANL-E, BNL, LBNL, ORNL, PNNL and SLAC. Two of these labs, ANL-E and BNL, contributed 42 percent of all SC's RCRA waste in 1998. The increase in RCRA wastes at ANL-E in 1998 is the result of laboratory clean-outs and inventory reduction.

RCRA waste generation has decreased by more than 50 percent since 1993 at BNL, LBNL, and SLAC. PNNL's generation of RCRA waste initially seemed to increase over the 1993 baseline because a moratorium on waste shipment was in place during the baseline year 1993. The next year, 1994, saw the lifting of the moratorium with a sharp increase in the number of metric tons of RCRA waste reported at PNNL. The 1994 figures do not indicate an increase in waste generation, but reflect the quantities of RCRA wastes that were shipped off-site for disposal. Subsequent years reflect a continual reduction of waste because of waste minimization efforts.

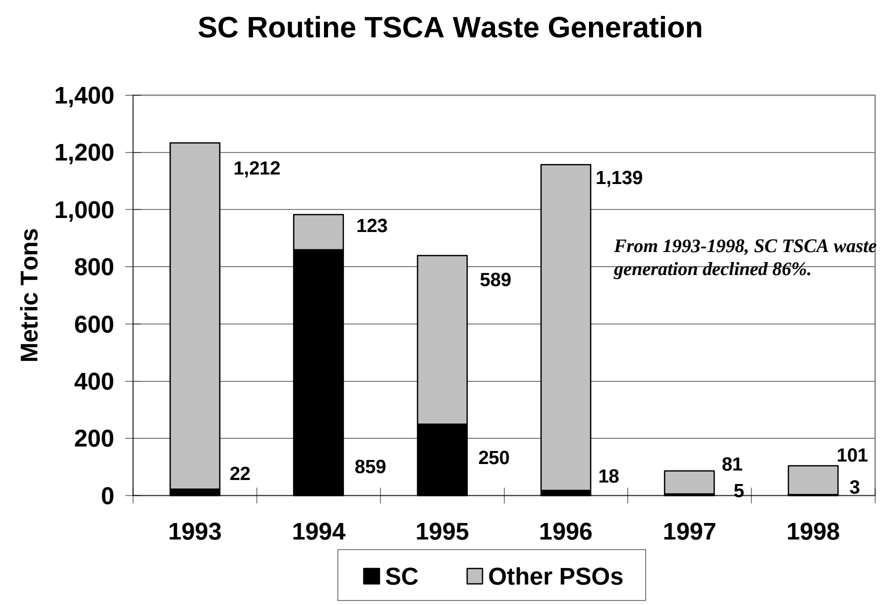
Figure 7



2.4.3 TSCA Wastes

TSCA wastes are individual wastes, such as asbestos or polychlorinated biphenyls (PCBs), that fall under the regulation of the Toxic Substances Control Act (TSCA). The majority of TSCA wastes are not generated by operations, but result from the disposal of equipment, such as transformers, or from the demolition of buildings containing asbestos. These disposal activities are not part of the legacy clean-up, so the resultant TSCA wastes are considered routine. Figure 8 (Page 11) presents SC's generation of TSCA wastes. SC's generation of routine TSCA wastes peaked in 1994, and constituted 87 percent of the DOE total. This peak may be attributable to one-time disposal activities at ongoing SC operations. In subsequent years, routine TSCA waste generation has decreased. In 1998, SC generated a minimal three metric tons at BNL and TJNAF, equivalent to three percent of the DOE total. In the future, SC will probably generate occasional peaks of TSCA wastes from renovations and building demolitions.

Figure 8



2.5 Total Radioactive Waste Generation

Total radioactive wastes in SC are the combined quantities of LLW, MLLW and TRU. As seen in Figure 9 (Page 12), total radioactive wastes have declined in comparison to the 1993 baseline. Although SC total radioactive waste generation increased from 1997 to 1998, the total amount is still less than 50 percent of 1993 baseline levels. Since 1993, SC has consistently contributed about five percent of the total DOE wastestream for these two types of wastes. The majority of this contribution is in LLW; SC contributed six percent of the DOE total in 1998. SC generated three percent of the total DOE MLLW wastestream in 1998.

Percent Change in SC Total Radioactive Waste Generation from 1993-1998

ANL-E	BNL	Fermi	ORNL	PNNL	All Others
+3%	-23%	+60%	-82%	-90%	-12%

Figure 9

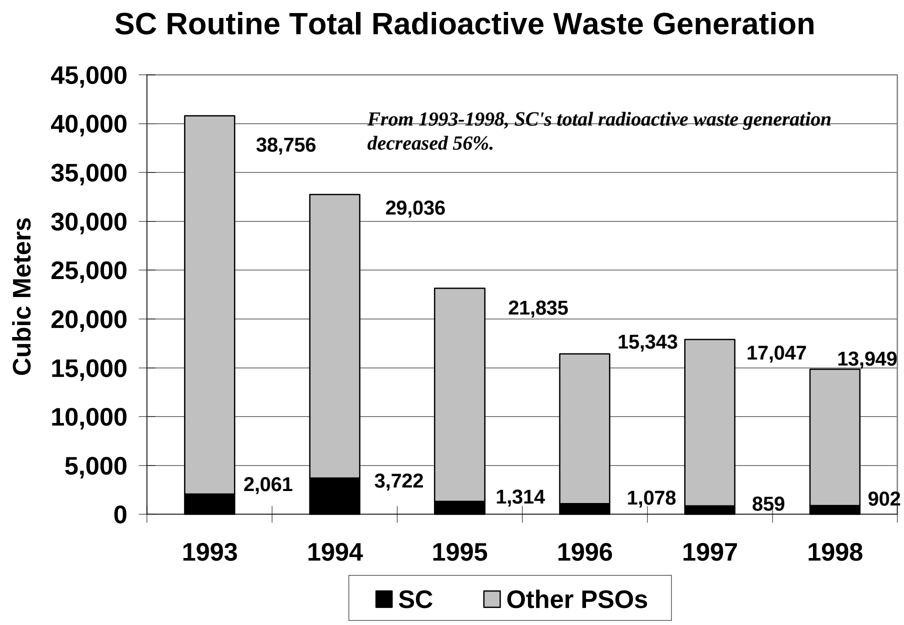
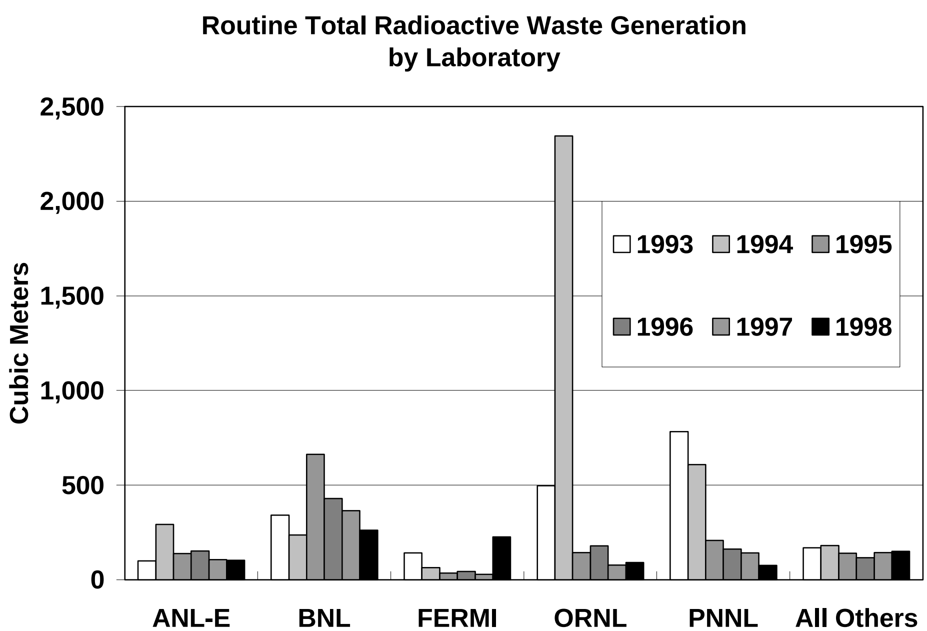


Figure 10 shows total radioactive waste generation trends in SC laboratories. In 1998, five laboratories generated 85 percent of SC radioactive wastes: ANL-E, BNL, Fermi, ORNL, and PNNL. BNL generated more than 30 percent of all of SC's radioactive wastes, and about 2 percent of the DOE total.

ANL-E services radioactive wastes generated by other programs located on site, such as the Office of Nonproliferation and National Security at New Brunswick Laboratory. It is possible that some of these wastes were incorrectly designated as SC-generated, and were included in the figures reported to EM-77.

Figure 10



2.5.1 Low-Level Wastes (LLW)

Low-level wastes are radioactive wastes that are not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material. Figure 11 shows SC's generation of LLW from 1993 to 1998. SC's LLW generation has declined 55 percent from 1993 levels. Figure 12 (Page 14) shows LLW generation by laboratory. Four laboratories contributed about 75 percent of SC's LLW over this three-year period: ANL-E, BNL, ORNL, and PNNL. ANL-E's generation of LLW increased during 1998 as the result of a new laboratory strategy to prevent accumulation and expedite the shipment of LLW off-site. BNL has been SC's largest generator from 1995 to 1998, contributing 30 percent of the SC total. After a peak in 1994, ORNL's LLW generation has fallen to 19 percent of its 1993 level. After years of steady declines, Fermi's generation of LLW increased by 62 percent above the 1993 baseline. The additional low-level wastes were generated during accelerator shutdown activities in preparation for the commissioning of the new Fermilab Main Injector (FMI).

Figure 11

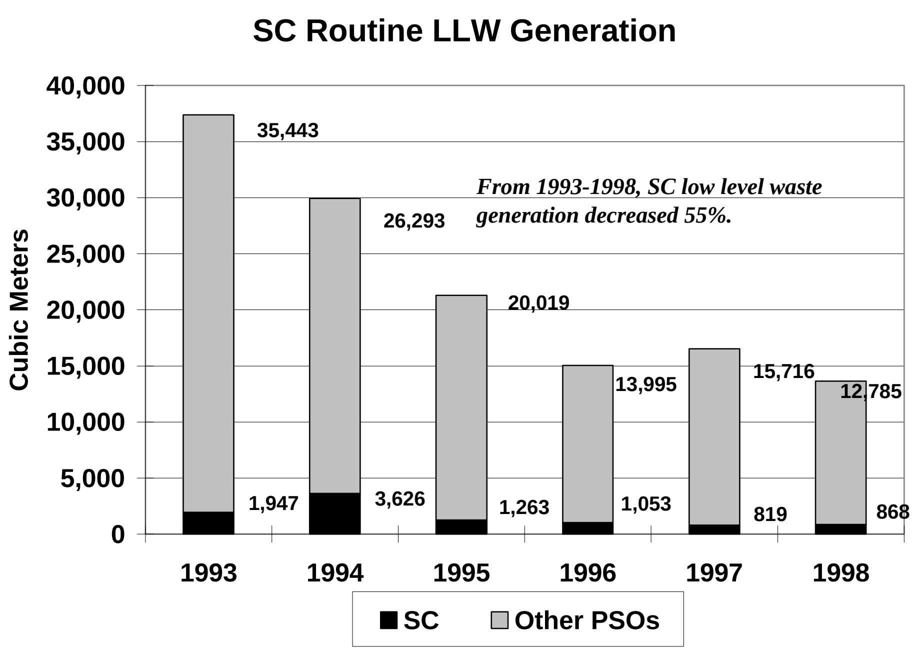


Figure 12

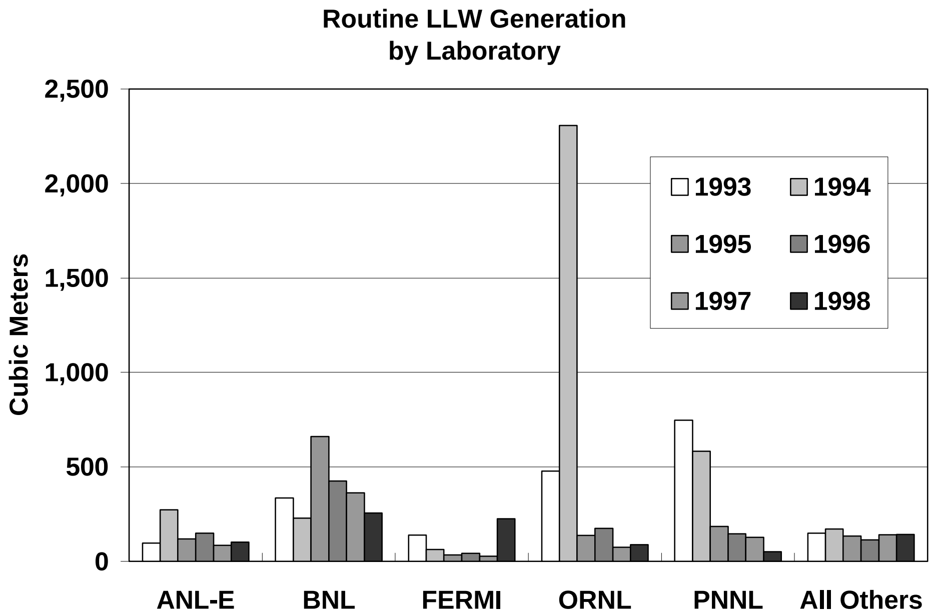


Figure 12 is based on official DOE figures, which report 2306 cubic meters of LLW at ORNL in 1994. ORNL's records report generation of 126 cubic meters of LLW in 1994. Official DOE records report that FERMI generated 140 cubic meters of LLW in 1993 and 226 cubic meters in 1998. Fermi's records report generation of 77 cubic meters of LLW in 1993, and 131 in 1998, which is equivalent to a 69 percent increase.

Percent Change in SC LLW Generation from 1993-1998					
ANL-E	**BNL**	**Fermi**	**ORNL**	**PNNL**	**All Others**
-15%	**-24%**	**+62%**	**-82%**	**-93%**	**-4%**

2.5.2 Mixed Low-Level Wastes (MLLW)

Mixed low-level wastes are low-level wastes that contain a RCRA waste component. SC has never generated large quantities of MLLW. Figure 13 (Page 15) presents SC's MLLW generation. SC's greatest volume of MLLW, 96 cubic meters, was generated in 1994 at 13 laboratories. In 1998, SC operations generated MLLW at five laboratories: BNL, LBNL, LLNL, ORNL and PNNL. In 1993, LBNL originally reported generation of 36 cubic meters of MLLW. A subsequent review of records showed that SC only generated 4.28 cubic meters of MLLW in 1993, which is the quantity cited in this report. Figure 14 (Page 15) summarizes SC MLLW generation by laboratory.

Figure 13

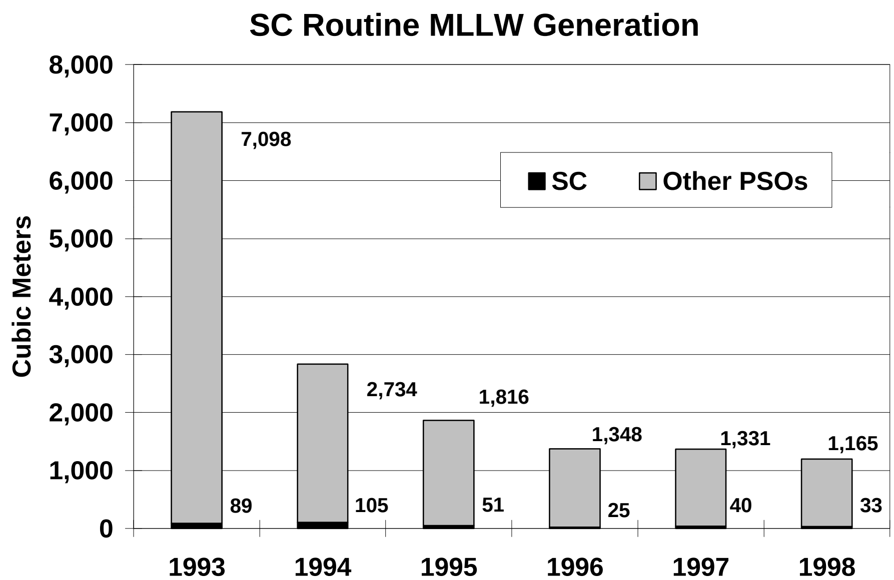
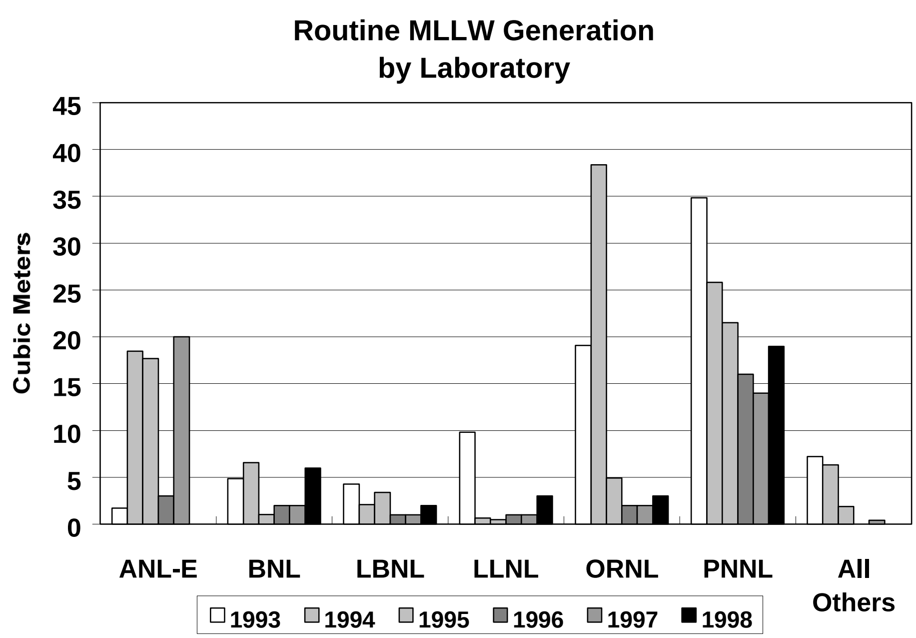


Figure 14



Percent Change in SC MLLW Generation from 1993-1998						
ANL-E	BNL	LBNL	LLNL	ORNL	PNNL	All Others
-100%	+24%	-53%	-70%	-84%	-45%	-87%

2.5.3 Transuranic Wastes (TRU)

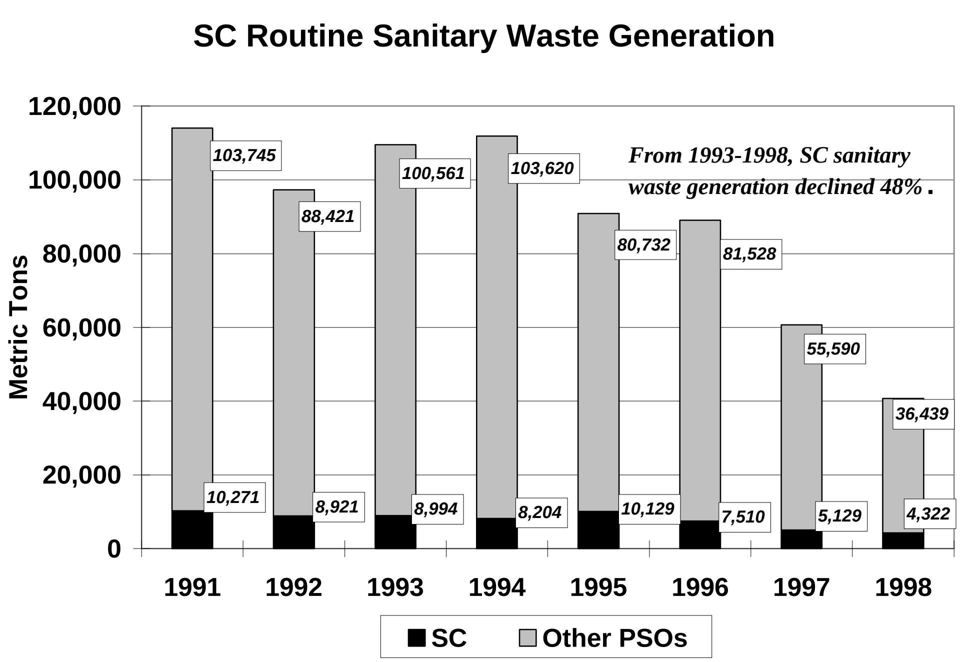
Transuranic wastes contain more than 100 nanocuries per gram of an alpha-emitting radionuclide that is heavier than uranium (atomic number 92). From 1993 to 1998, SC operations at the ORNL High Flux Isotope reactor sporadically generated small quantities of TRU waste. ORNL had a peak of 24 cubic meters in 1994; generation in all other years was less than one cubic meter. In 1998, PNNL research generated 4 cubic meters of TRU waste in support of the cleanup of the Hanford Complex.

2.6 Sanitary Waste Generation and Recycling

2.6.1 Sanitary Waste Generation

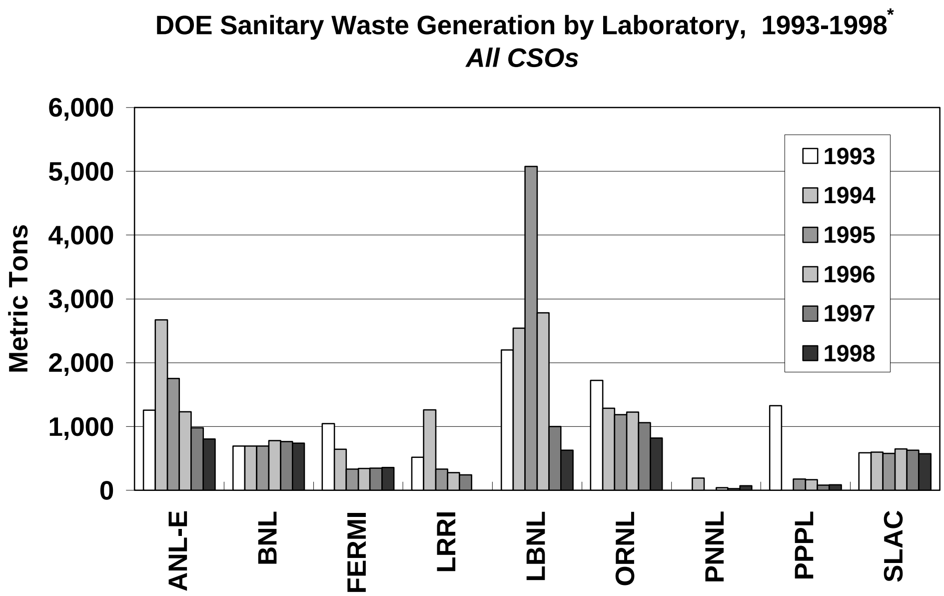
Sanitary wastes are wastes generated by normal housekeeping that are not hazardous or radioactive (i.e., garbage). Figure 15 compares sanitary waste generation at SC sites to the rest of DOE from 1993 to 1998. SC routine sanitary waste generation decreased 48 percent in 1998 compared to the 1993 baseline. Figure 16 (Page 17) shows sanitary waste generation trends from all PSOs at individual laboratories. The sanitary waste data presented in Figure 16 were reported from laboratories as an entity; data were not available for

Figure 15



SC's share of the sanitary waste generation at the laboratory level. Laboratory-level data were unavailable for four sites: Ames, LBNL, LLNL, and LRRI. Furthermore, the sanitary waste summary data do not capture sanitary waste management practices at individual laboratories. For example, a significant portion of PNNL's sanitary waste, such as that generated at leased facilities, is not tracked by weight and is not included in these figures. The increase in sanitary waste generation at LBNL in 1995 arose from vegetation removal as part of a one-time fire protection program.

Figure 16

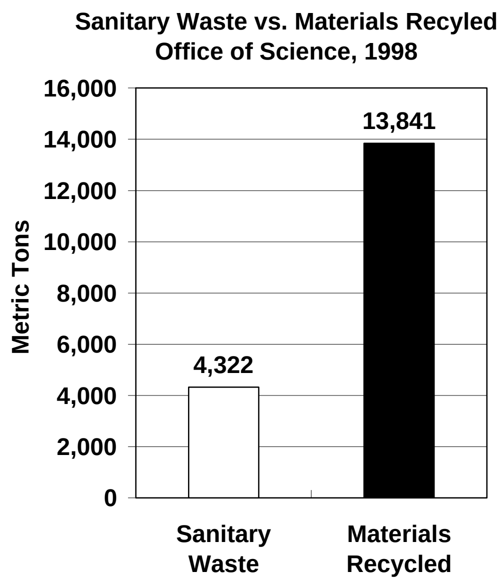


*Available data. Some cleanup waste may be counted in the 1993-1994 figures.

Percent Change in SC Sanitary Waste Generation from 1993-1998

ANL-E	BNL	Fermi	LRRI	LBNL	ORNL	PPPL	SLAC
-36%	+7%	-66%	N/A	-71%	-39%	-93%	-3%

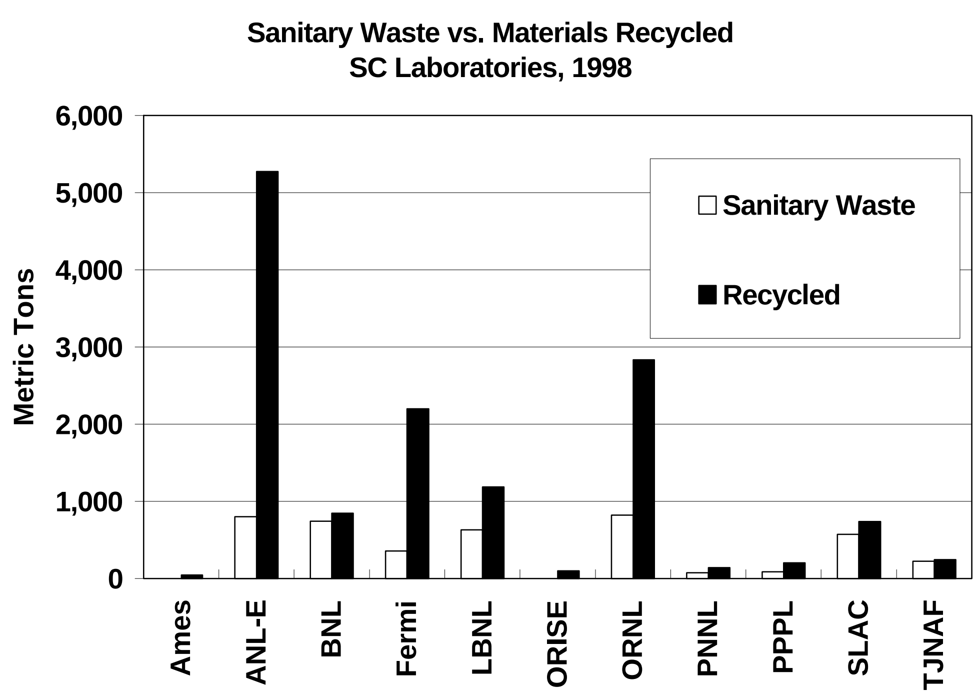
Figure 17



2.6.2 Recycling

The large decreases in sanitary waste generation may be attributable to successful recycling programs at SC laboratories. Figure 17 shows that the quantity of recycled materials (paper, scrap metals, precious metals, and other products) is more than three times the quantity of sanitary wastes generated in 1998. This trend is present at every SC laboratory, as seen in Figure 18.

Figure 18



2.7 Trends in SC Waste Generation

2.7.1 Relative Contribution of SC Sites

Waste generation data show that each SC laboratory continues to significantly reduce its hazardous and radioactive wastestreams. An overview of site-specific pollution prevention accomplishments is presented in Appendix A of this update.

Table 4 (Page 20) shows the top ten generators of all routine wastes for all PSOs in DOE (e.g., DP, EM, NE, etc.) and shows that SC's relative ranking among waste generators is declining as waste generation declines. Two SC laboratories, ANL-E and ORNL, have been among the top ten for the reporting period, despite the fact that SC does not generate all types of routine waste. The addition of BNL to the 1998 list of top ten DOE generators reflects SC's relative prominence in the DOE total wastestream. Table 5 (Page 21) shows the top ten generators of routine wastes for SC only. Table 6 (Page 21) presents the top ten generators of SC wastes in 1998 by waste type. In 1998, SC operations at all laboratories generated only ten percent of DOE's routine wastes, down from approximately twelve percent from 1995 to 1997.

Figure 19 shows that three laboratories: ANL-E, BNL, and Fermi, generated about 65 percent of all of SC's routine hazardous and radioactive wastes in 1998. ANL-E generated about 19 percent of routine hazardous waste reported in SC from 1994 to 1998 and 20 percent of DOE's routine hazardous waste. However, wastes from other PSOs may have been incorrectly attributed to SC at ANL-E, BNL and ORNL at some point in the reporting period. If the waste generation figures reported here are inflated by non-SC wastes, SC's contribution to the overall DOE wastestream would be even less than reported. Dismantling of experiments and construction associated with the new Fermilab Main Injector at Fermilab produced unusually high quantities of waste in 1998.

Figure 19

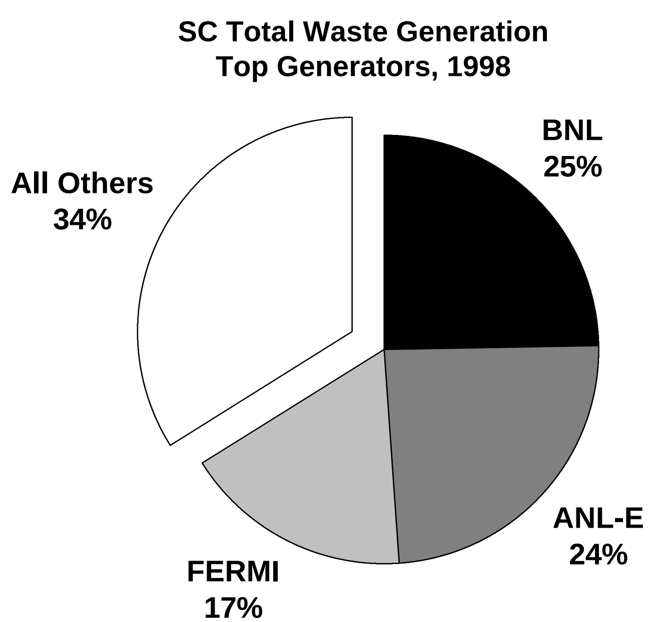


Table 4: Top Ten Generators of DOE Routine Wastes , 1993-1998 *Includes Waste Generation for All PSOs* Metric Tons*												
Rank	1993		1994		1995		1996		1997		1998	
1	SRS	14,739	SRS	9,568	SRS	10,895	SRS	8,833	SRS	9,072	SRS	9,461
2	Y-12	3,995	Hanford	4,981	Hanford	3,063	INEEL	2,186	INEEL	2,311	Y-12	2,446
3	Hanford	3,919	INEEL	4,908	INEEL	2,187	**ANL-E**	1,528	Y-12	1,978	INEEL	1,324
4	LANL	3,004	NTS	4,441	K-25	2,151	Hanford	1,528	Fernald	1,708	LANL	939
5	Ports.	2,251	**ORNL**	3,433	**ANL-E**	2,027	Fernald	1,059	**ANL-E**	1,453	Hanford	711
6	Fernald	2,181	**ANL-E**	2,876	Bonnv.	1,340	Y-12	1,029	Hanford	972	LLNL	550
7	Mound	1,874	Mound	2,841	LANL	1,287	**ORNL**	939	**BNL**	804	**ANL-E**[1]	378
8	**ORNL**	1,781	Y-12	2,308	**ORNL**	995	Mound	766	**ORNL**	691	Fernald	528
9	Pantex	1,779	LANL	2,134	Rocky F.	964	Rocky F.	726	Mound	591	**BNL**	390
10	WVDP	1,450	Bonnv.	2,016	Mound	767	LANL	708	LANL	507	**ORNL**	324
*Note: Assumes that one cubic meter equals one metric ton. [1]. SC's waste generation at ANL-E was 378 metric tons.												

Table 5: Ranking of Waste Generation by SC Lab, 1998 Hazardous and Radioactive Wastes		
Rank	**Lab**	**Totals Metric Tons**
1	BNL	390
2	ANL-E	378
3	FERMI	268
4	ORNL	117
5	PNNL	115
6	LLNL	78
7	SLAC	61
8	LBNL	51
9	LRRI	29
10	PPPL	27
11	LANL	24
12	TJNAF	18
13	AMES	9
14	SNL-CA	6
15	ORISE	1
16	OSTI	2
	SC TOTAL:	1,574

Table 6: Generators of SC Routine Wastes in 1998 Ranked by Waste Type *Rounded to Nearest Unit*												
Rank	**Radioactive Wastes (Cubic Meters)**						**Hazardous Wastes (Metric Tons)**					
	LLW		*MLLW*		*TRU*		*State*		*RCRA*		*TSCA*	
1	BNL	256	PNNL	19	PNNL	4	ANL-E	224	ANL-E	52	BNL	2
2	FERMI	226	BNL	6			BNL	75	BNL	51	TJNAF	1
3	ANL-E	102	ORNL	3			FERMI	36	PNNL	30		
4	ORNL	88	LLNL	3			SLAC	34	SLAC	27		
5	LLNL	72	LBNL	2			LANL	21	ORNL	26		
6	PNNL	52					LBNL	18	LBNL	18		
7	LRRI	26					PNNL	10	AMES	9		
8	PPPL	15					PPPL	4	PPPL	8		
9	TJNAF	14					SNL-CA	1	FERMI	6		
10	LBNL	13							SNL-CA	1		
11	LANL	3							LLNL	3		
12	SNL-CA	1							LRRI	3		

2.7.2 Waste Generation Per Operating Dollar

Figure 20

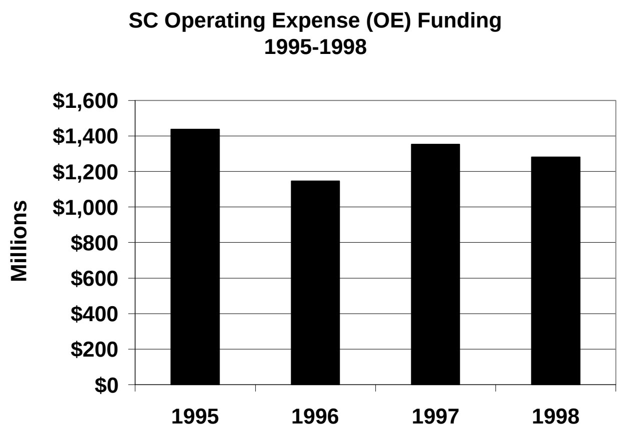
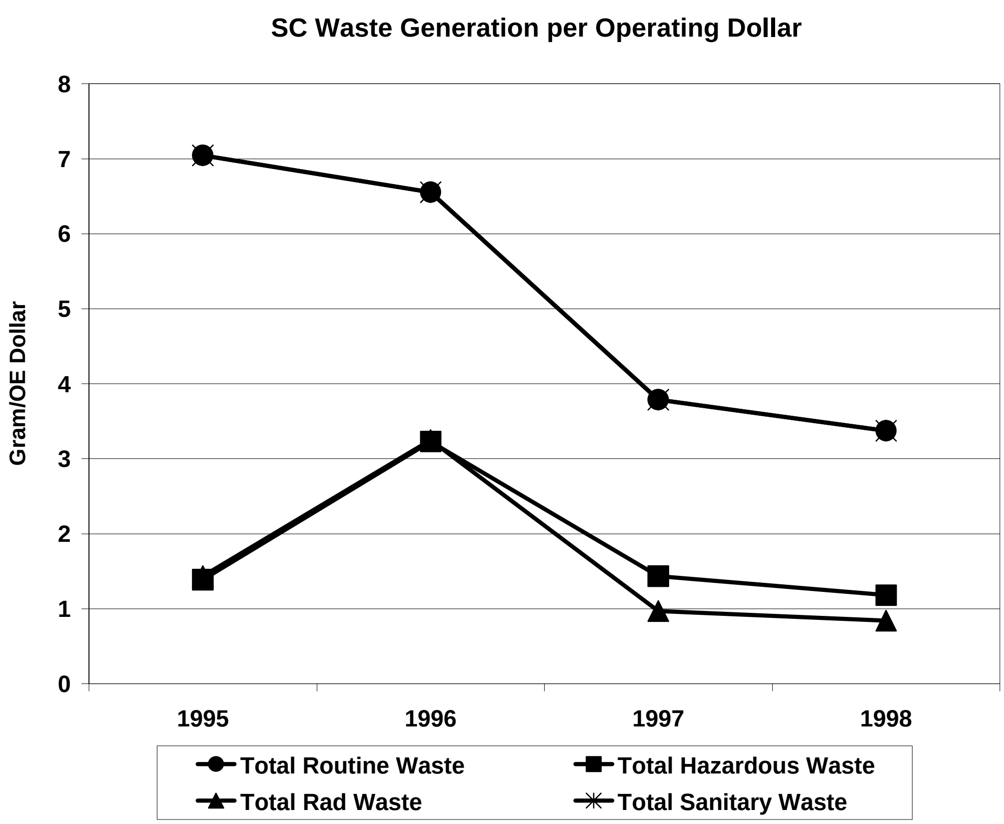


Figure 20 shows SC Operating Expense (OE) funding from 1995 to 1998. A a ratio of waste output (kilograms) to inputs (operating dollars used for labor and supplies was developed to measure waste generation against the level of activity in SC. Figure 21 shows the kilograms of waste generated per operating dollar in SC. Since 1995, SC has dereased its generation of all types of routine waste as activity levels remained constant. This decrease is a sign of successful waste avoidance from increased recycling, pollution prevention measures in existing projects, and from new research activities that generate less waste by design.

Figure 21



3.0 SC Affirmative Procurement

Affirmative Procurement is the acquisition of products that have been manufactured completely or partially from recycled materials. Executive Order (EO) 13101, *Greening the Government*, requires that each federal agency establish an Affirmative Procurement Program. Initially, the program required the purchase of just five products: re-refined lubricating oil, retreaded tires, insulation containing recovered materials, and concrete and cement containing fly-ash or furnace slag. By 1997, over 20 products with recycled content were required to be purchased. The EO requires government agencies to achieve 100 percent acquisition of the listed recycled products, and directs the U.S. Environmental Protection Agency (EPA) to expand the list by continuously designating products with recycled content as they become available on the market at a reasonable price. The final rule of the Department of Energy Acquisition Regulations (DEAR) of October 13, 1995 requires the acquisition and use of environmentally preferable products and services by DOE and its management and operations (M&O) contractors. In 1996, the Secretary of Energy set the DOE-wide goal of 100 percent affirmative procurement of listed recycled products by December 1999. The Secretary of Energy reaffirmed the Department's commitment to 100 percent procurement of recycled goods by 2005.

3.1 Affirmative Procurement Evaluation

The EM Office of Pollution Prevention supplied the data on SC's affirmative procurement from the DOE Affirmative Procurement Reporting System (APRS). In accordance with OMB requirements, the system reports total dollar amounts of the EPA-designated items and the dollar amounts expended on the same items which have recycled content. Paper products purchased under GSA auspices and airplane tires are not included. It is not possible to determine the quantities of the EPA-designated items from the dollar figures. The APRS reports on total dollars spent without adjusting for inflation. Relative costs of the recycled items vary widely; recycled tires are cheaper than the new counterparts, while recycled paper generally costs more than virgin paper. EO 13101 does not require acquisition of recycled products that are not cost-competitive or which do not meet technical specifications.

Data are reported from sites where SC is the landlord. It should be noted that all purchases were attributed to SC at these sites, even though other programs may be operating there.

3.2 Summary of Affirmative Procurement Results

Table 7 (Page 24) shows that SC achieved an 83 percent Affirmative Procurement rate in 1997. Please note that the adjusted total purchases are presented here; the figures do not include products that were not available, did not meet technical specifications, or were not cost competitive. These exclusions are permitted in the Cost, Availability, or Performance (CAP) clause of the EO. Tables 8 through 10 (Pages 25-27) show Affirmative Procurement rates for specific product categories. These product categories include an expanded list of products. For example, vehicular products are reported instead of just tires or oil. The purchases reported here are from the EM-77 Annual Report of September 1999; some laboratories have updated their information since then.

Table 7: 1998 Affirmative Procurement at SC Laboratories			
Lab	**All Products**		
	Total	Recycled	% Recycled
Ames	$92,293	$60,678	66%
ANL-E	$502,380	$501,000	99%
BNL	$428,940	$340,250	79%
FERMI	$992,798	$943,630	95%
LBNL	$414,535	$342,286	83%
ORNL	$3,954,068	$3,133,880	79%
PNNL	$309,453	$241,500	78%
PPPL	$58,136	$31,712	79%
SLAC	$167,764	$148,941	89%
TJNAF	$141,617	$112,129	79%
SC Totals:	**$7,092,900**	**$5,856,892**	**83%**
DOE-Wide % Recycled:			*85%*

Table 8: 1998 Affirmative Procurement at SC Laboratories

Lab	Paper			Non-Paper		
	Total	Recycled	% Recycled	Total	Recycled	% Recycled
Ames	$47,364	$37,288	79%	$44,105	$23,155	52%
ANL-E	$390,000	$390,000	100%	$89,500	$89,000	99%
BNL	$91,799	$88,825	97%	$40,381	$40,381	100%
FERMI	$113,009	$113,009	100%	$111,917	$80,253	72%
LBNL	$297,987	$297,987	100%	$44,299	$44,299	100%
ORNL	$2,491,282	$2,251,220	90%	$721,437	$362,853	50%
PNNL	$176,978	$124,777	71%	$114,475	$98,723	86%
PPPL	$25,763	$19,430	75%	$19,506	$6,973	36%
SLAC	$116,255	$116,255	100%	$29,416	$29,416	100%
TJNAF	$55,473	$42,282	76%	$53,316	$37,019	69%
Subtotals:	$3,805,910	$3,481,083	91%	$1,268,082	$812,072	64%
Examples of paper products: copier, office and computer paper.				*Examples of non-paper products: binders, plastic desktop accessories, plastic envelopes, toner cartridges.*		

Table 9: 1998 Affirmative Procurement at SC Laboratories						
Lab	**Construction**			**Landscape**		
	Total	Recycled	% Recycled	Total	Recycled	% Recycled
Ames	$824	$235	29%	$0	$0	NA
ANL-E	$15,000	$15,000	100%	$0	$0	NA
BNL	$205,868	$205,868	100%	$0	$0	NA
FERMI	$738,140	$738,140	100%	$0	$0	NA
LBNL	$65,867	$0	0%	$0	$0	NA
ORNL	$564,599	$438,873	78%	$30,916	$30,916	100%
PNNL	$18,000	$18,000	100%	$0	$0	NA
PPPL	$12,117	$4,559	38%	$750	$750	100%
SLAC	$3,270	$3,270	100%	$0	$0	NA
TJNAF	$32,828	$32,828	100%	$0	$0	NA
Subtotals:	$1,656,513	$1,456,773	88%	$31,666	$31,666	100%
Examples of construction products: insulation, cement and concrete containing ash or slag, structural fiberboard, laminated fiberboard, reprocessed latex paint.				*Examples of landscape products: garden and soaker hoses, hydraulic mulch, lawn and garden edging, yard trimmings compost.*		

Table 10: 1998 Affirmative Procurement at SC Laboratories						
Lab	**Vehicular**			**Transportation**		
	Total	Recycled	% Recycled	Total	Recycled	% Recycled
Ames	$0	$0	NA	$0	$0	NA
ANL-E	$3,940	$3,940	100%	$0	$0	NA
BNL	$45,446	$2,588	6%	$0	$0	NA
FERMI	$14,866	$6,114	41%	$0	$0	NA
LBNL	$3,191	$0	100%	$0	$0	NA
ORNL	$72,917	$9,549	13%	$30,916	$30,916	100%
PNNL	$0	$0	NA	$0	$0	NA
PPPL	$0	$0	NA	$0	$0	NA
SLAC	$1,609	$0	0%	$15,875	$0	0%
TJNAF	$0	$0	NA	$0	$0	NA
Subtotals:	$141,969	$22,191	16%	$46,791	$30,916	66%
Examples of transportation products: channelizers, delineators, flexible delineators, parking stops, traffic barricades, and traffic cones.				*Examples of vehicular products: engine coolants, re-refined oils, retread tires.*		

4.0 Toxics Release Inventory (TRI) Trends

Executive Order (EO) 12856, Compliance with Right-to-Know Laws and Pollution Prevention Requirements, obligates DOE to comply with the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. The EO requires all federal agencies to reduce toxic emissions and off-site transfers to 50 percent of the 1993 baseline by December 31, 1999. DOE issued its strategy for meeting these requirements in December 1995. Businesses and government facilities that use more than 10,000 pounds/year of a listed toxic chemical must report transfers and releases to EPA.

Table 11 (Page 29) shows the releases and transfers of listed chemicals by SC sites from 1993-1998. Trends in TRI reduction are not evident. Total Toxics Release Inventory (TRI) transfers and releases in 1996 were 85 percent below the 1993 baseline, a reduction that exceeds the Departmental reduction goals. However, 1997 TRI transfers and releases were 53 percent over the baseline, and 1998 TRI releases and transfers were 267 percent over the baseline.

Reported TRI releases reflect both ongoing operations, such as the use of nitric acid in wastewater treatment, and operations that vary with circumstances, such as the replacement of ethylene glycol coolant at Fermi. ORNL's reported releases of nitrate compounds are a necessary component of its wastewater treatment. In 1997, ORNL was obligated to report the use of hydrochloric acid released from the burning of coal in its steam plant. Many laboratories decreased their TRI emissions completely, or reduced the quantities of TRI chemicals used to below reporting threshold. Zeros in Table 11 may indicate that emissions were totally eliminated or that the quantities of the TRI chemical fell below the reporting threshold of 10,000 pounds per year.

The TRI releases do not necessarily signify harm to the environment. ORNL was obligated to report the quantities of nitric and hydrochloric acids used for wastewater treatment as a release even though all discharges to the environment were within the laboratory's National Pollutant Discharge Elimination System (NPDES) limits. Similarly, ORNL's reported lead transfers are an indication of the beneficial re-use of lead in the on-site lead shop. The ORNL lead shop is supporting reuse, reshaping, and recycling of lead for numerous DOE sites. Off-site transfers and slag from remelting are reported on the TRI form, despite the fact that these activities prevent the generation of large amounts of hazardous lead waste.

Table 11: SC TRI Releases to the Environment, 1993-1998 Quantities in Pounds									
Lab	Chemical	1993 Releases & Transfers (a)	1994 Releases & Transfers (a)	1995 Releases & Transfers (a)	1996 Releases & Transfers (a)	1997 Releases & Transfers (a)	1998 Releases & Transfers (a)	Percent Change 1997-1998 (b)	**Percent Change 1993-1998 (b)**
ANL-E	1,2,4-Trimethylbenzene	29	9	0	0	0	0	NA	-100%
	Benzene	23	5	0	0	0	0	NA	-100%
	Methanol	12	18	0	0	0	0	NA	-100%
	Methyl-tert-butyl Ether	86	5	0	0	0	0	NA	-100%
	*Sulfuric Acid	7	2,400	--	--	--	--	NA	-100%
	Toluene	144	10	0	0	0	0	NA	-100%
	Xylenes	144	20	0	0	0	0	NA	-100%
BNL	Acetone	1,930	2,030	0	0	0	0	NA	-100%
	Chlorine	170	466	250	0	0	0	NA	-100%
	Methanol	2,110	1,860	1,858	0	0	0	NA	-100%
	*Sulfuric Acid	330	0	--	--	--	--	NA	-100%
	1,1,1-Trichloroethane	1,105	0	0	0	0	0	NA	-100%
Fermi	1,2,4-Trimethylbenzene	72	8,553	460	0	0	0	NA	-100%
	Hydrochloric Acid	76	450	40	0	0		NA	-100%
	Bromotrifluoromethane	0	318	262	167	0	0	NA	NA
	Ethylene Glycol	1,209	1,070	1,441	1,000	3,528	1,740	-51%	44%
	Trichlorofluoromethane	1,800	0	0	650	0	0	NA	-100%
ORNL	Chlorine	7,146	0	0	0	0	0	NA	-100%
	Copper Compounds	0	0	0	0	348	0	-100%	100%
	Hydrochloric Acid	0	0	81	0	46,508	49,123	6%	100%
	Lead	0	0	5,930	3,751	6,816	5,346	-22%	100%
	Methanol	164	0	272	107	436	906	108%	452%
	Nitrate Compounds						64,000	100%	100%
	Nitric Acid	43	0	31,422	1	129	1,204	833%	2,700%
	*Sulfuric Acid	0	1	--	--	--	--	NA	NA
	Tetrachloroethene	0	0	0	0	0	0	NA	NA
SLAC	1,1,1-Trichloroethane	12,700	16,300	0	0	0	0	NA	-100%
	*Sulfuric Acid	4,000	12,600	--	--	--	--	NA	-100%
	SC TOTAL:	33,300	46,115	42,016	5,676	57,765	122,319	**112%**	**267%**

(a) Include non-point air releases, point air releases, water releases, underground injection releases, land releases, and total off-site transfers for treatment and/or disposal.
(b) Percent change - negative number equals % decrease, positive number equals % increase. NA is not applicable. *Sulfuric acid is not subject to reporting after 1994.

5.0 SC Pollution Prevention Funding

In addition to establishing TRI requirements, EO 12856 also requires that all federal agencies formulate and fund pollution prevention activities. Funding for pollution prevention activities is requested in the Federal Agency Pollution Prevention and Abatement Planning Process and through agency budget requests.

Pollution prevention is a functional area of the Environment, Safety, and Health (ES&H) Management Plan. Table 12 shows pollution prevention funding referenced in Activity Data Sheets (ADS) from the FY 2000 ES&H Management Plan. Pollution prevention funding by SC Program is presented in Table 13 (Page 31). The funding levels presented here are from SC only. These figures represent SC's planned funding for pollution prevention and waste minimization activities; the actual funding received and expended may be different. Certain activities, which were incorrectly listed as pollution prevention (e.g., waste management or decommissioning and demolition), were not included in the figures presented here. Please note that sites may use overhead funds for pollution prevention activities. In addition, site pollution prevention projects also receive funding from other sources, such as EM. None of these additional funding sources are included in Tables 12 and 13, or in Figure 22 (Page 32).

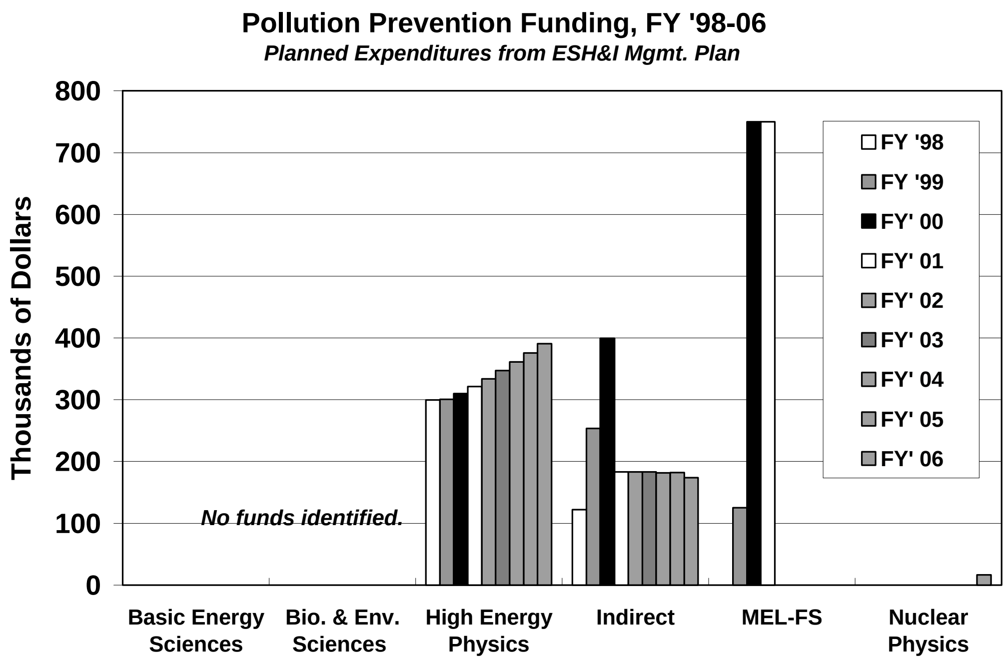
Table 12: SC Pollution Prevention Funding Figures from the FY 2001-2005 ESH&I Management Plan

Facility	No. of ADSs	Total Dollars (Thousands)		
		FY' 00	FY' 01	FY'02
Ames[1]	0	0.00	0.00	0.00
ANL-E[1]	0	0.00	0.00	0.00
BNL	6	1,013.60	796.00	46.90
Fermi	1	310.10	321.00	333.70
LANL[1]	0	0.00	0.00	0.00
LBNL[1]	0	0.00	0.00	0.00
ORISE	1	5.40	5.60	5.80
ORNL[1]	3	130.40	130.40	130.40
PNNL	0	0.00	0.00	0.00
PPPL[2]	0	0.00	0.00	0.0
SLAC[1]	0	0.00	0.00	0.00
TJNAF[1]	0	0.00	0.00	0.00
TOTAL:	**11**	**1,759.40**	**1,253.90**	**516.70**

1. No ADSs with funds allocated to pollution prevention were identified.
2. Funds for waste management and caretaking of the TFTR were incorrected identified as pollution prevention, so they are not included in this table.

Table 13: Pollution Prevention Funding by SC Program Dollars in Thousands									
Facility	**Multiprogram Energy Labs-Facility Support (MEL-FS)**			**Office of High Energy Physics**			**Indirect**		
	FY'00	**FY'01**	**FY'02**	**FY'00**	**FY'01**	**FY'02**	**FY'00**	**FY'01**	**FY'02**
BNL	750.00	750.00	0.00				263.60	46.90	46.90
FERMI				310.10	321.00	333.70			
ORISE							5.40	5.60	5.80
ORNL							130.40	130.40	130.40
PNNL									
PPPL									
TOTAL:	750.00	750.00	0.00	310.10	321.00	333.70	339.30	182.90	183.00

Figure 22


Pollution Prevention Funding, FY '98-06
Planned Expenditures from ESH&I Mgmt. Plan
Thousands of Dollars
800
700
600
500
400
300
200
100
0
No funds identified.
Basic Energy Sciences
Bio. & Env. Sciences
High Energy Physics
Indirect
MEL-FS
Nuclear Physics
FY '98
FY '99
FY' 00
FY' 01
FY' 02
FY' 03
FY' 04
FY' 05
FY' 06

Appendix A

1998 Pollution Prevention Accomplishments at SC Laboratories

Argonne National Laboratory-East (ANL-E)

ANL-E conducted 20 pollution prevention projects in 1998, which reduced waste by **20,587 metric tons** for estimated savings and cost avoidance of **$6,364,134**. Examples of specific projects include:

Recycling

- Environmental Management Operations (EMO) personnel have worked with Commonwealth Edison since January 1997 to establish an outlet for the Laboratory's fly ash. ANL-E established a contract with American Fly Ash to recycle fly ash generated at the Laboratory coal-burning boiler house. A total of 135.08 metric tons of fly ash were recycled at savings of $3,600 to the Laboratory. This agreement reduces the laboratory's fly ash disposal costs by 50 percent and diverts large volumes of material from the Laboratory's waste stream.

- Plant Facilities and Services-Utility Systems (PFS-US) sold 678.4 metric tons of coal fines to a recycler. The revenues generated from the sale of coal fines and savings amounted to $28,297.

- ANL-E renewed its contract with Safety Kleen for re-refining used oil. The new contract contains both a reduced price per gallon and reduced price for sample analysis, for overall unit price reduction of 37 percent. ANL-E shipped 1,250 gallons of used oil to Safety Kleen, and recycled empty drums as metal scrap. In addition, ANL-E shipped 31,699 pounds of parts washer cleaning fluid, nonhazardous petroleum naphtha, immersion cleaner, and used oil and oily water to Safety Kleen for recycling/reuse.

- Argonne's Plant Facilities and Services-Facility Engineering and Construction developed and managed an extension bridge demolition and construc0t32/5*714ion project that resulted in the recycling of 100 percent of the project materials. The original bridge was constructed with 18 pre-stressed, pre-cast concrete deck beams (36" wide by 30' long and 17" deep). Each beam weighed 17,000 pounds. The contractor was able to reuse the old deck beams for construction of new piers and docks at a marina in Seneca, IN on the Illinois River. All the demolition materials were recycled on this project, including steel guard rails, asphalt paving and 153 tons of concrete. Total savings from reuse and recycling were $35,000.

- Argonne construction and demolition (C&D) projects recycled approximately 3,468.55 metric tons of material. Diverting these materials from the waste stream resulted in revenues and cost avoidance estimated at $118,154.

- ANL-E shipped 24 gas cylinders to Emergency Technical Services Corporation (ETSC), for recycling under a new gas cylinder reutilization service program. This program is only 25 percent of the cost of commercial disposal.

- During the second quarter of calendar year 1998 (CY98), Environmental Management Operations-Waste Management Operations (EMO-WMO) decontaminated 5,292 pounds of low-level radioactive lead using a carbon dioxide (CO2) pellet decontaminating system. The decontaminated lead was released to the ANL-E lead storage bank.

- Other quantities recycled:
  - more than 6,400 pounds of various sized lead-acid batteries
  - 1.41 metric tons of mercury containing fluorescent light bulbs
  - 11 empty gas cylinders
  - 104 metric tons of scrap metal (Savings: $32,020)
  - 396 tons of mixed office paper and additional materials (Savings: $13,675)
  - 20,000 pounds of computer tape reels
  - 1.62 metric tons of toner cartridges (Savings: $1,500)

Reuse

- ANL-E returned 402 out-of-service smoke detectors to the manufacturer.

- During the third quarter of CY98, approximately $20,000 worth of tools and $25,000 in equipment and materials were recycled/reused. The items were distributed across the Laboratory's operational departments as an alternative to disposal.

- Thirteen drums containing 6,000 pounds of dolomite were reused on site by the Plant Facility and Services-Grounds Division.

Waste Minimization

- During Fiscal Year 98 (FY98), the ANL-E Environmental Remediation Action Project performed an environmental restoration pollution prevention project titled *"Optimization of Enhanced Soil Mixing by Zero-Valent Iron Addition."* The enhanced soil-mixing process removes volatile organic compounds (VOCs) from soil. The increased removal efficiency and reduction in secondary waste volume resulting from the iron addition resulted in significant improvement of the cost effectiveness of the process. The alternate remedial approach for the type of contaminants and soil at the Laboratory would have required excavation of over 20,000 cubic yards of highly contaminated soil, which would have required on-site or off-site treatment. Some of the soil would have been classified as mixed waste due to the presence of low levels of radioactive materials in the soil. The ability to treat mixed waste containing the contaminants present at this site is extremely limited and expensive. The use of *in-situ* techniques eliminated a major wastestream which could have taxed an already overburdened disposal market.

- Sixteen neutron ion chambers containing boron trifluoride gas were successfully de-gassed on January 27, 1998. Each cylinder contained 1.5 liters of gas that was absorbed into water. The empty cylinders were then disposed of as metal scrap and the water was discharged to the laboratory wastewater treatment system. This effort saved $4,800 in commercial disposal costs.

Brookhaven National Laboratory (BNL)

BNL conducted four pollution prevention projects in 1998, which reduced waste by **324 metric tons** for estimated savings and cost avoidance of **$250,500**. Examples of specific projects include:

Recycling

- The Brookhaven National Laboratory Solid Waste Recycling Program continues to expand. During the first quarter of CY98 the following quantities of materials were recovered and recycled:
  - Paper: 33.2 tons
  - Bottles/Cans: 5.6 tons
  - Cardboard: 20.5 tons
  - Construction debris: 144.0 tons
  - Tires: 7.2 tons

- During the fourth quarter, 119 tons of paper, bottles, cardboard and tires were recycled resulting in avoided waste disposal costs.

Reuse

- Radioactively activated and contaminated lead bricks were segregated based on condition. Bricks found to be in good condition (i.e. no significant deformation) were set aside to be used as shielding walls in the construction of a new "hot cell" for the handling of radioactive waste. This resulted in avoided costs for both waste disposal and the purchase of new materials for the construction of new walls.

Waste Minimization

- A tin/lead plating process was modified with a tin-only plating process in the BNL Instrumentation Division printed circuit lab. The modification eliminated the source of lead in the entire process, thus eliminating many down-stream hazardous wastes and lead contamination of process rinse waters.

- BNL is in the process of performing RCRA closure of the old hazardous waste management facility. As part of that project, all mixed wastes were moved to the newly constructed waste management facility. Before the waste was moved, a detailed review of all characterization data was performed. The review resulted in the re-characterization of approximately 400 gallons of several wastes as non-RCRA. They were subsequently determined to be radioactive non-mixed wastes and were segregated, treated, and disposed.

Fermi National Accelerator Facility (Fermi)

Fermi conducted seven pollution prevention projects in 1998, which reduced waste by **942 metric tons**, for estimated savings and cost avoidance of **$213,340**. Examples of specific projects include:

Recycling

- The Particle Physics Division dismantled a lead-containing calorimeter and is recycling the lead and steel.
- Fermi recycled 700 tons of asphalt and 75 metric tons of concrete in 1998.
- Sanitary waste, including paper and cardboard, were routinely recycled.
- Fermi physically separated radioactive accelerator beam pipe chamber material from non-radioactive material, generating profit from recycling and saving disposal costs.

Waste Minimization

- Fermi replaced regular fluorescent lamps with Phillips Alto bulbs, which can thrown away in dumpsters, saving the lab $5600 in disposal costs.
- In 1998, Fermi Information Resources Department completed a four-year effort to electronically replace the monthly mailing of reprints. The result: $175,000 in annual savings, including $92,000 in postage, $78,000 in duplicating costs and $5,000 in mail preparation costs.

Oak Ridge National Laboratory (ORNL)

ORNL conducted 26 pollution prevention projects in 1998, which reduced waste by **41,443 metric tons** for estimated savings and cost avoidance of **$38,949,957**. Examples of specific projects include:

Recycling

- In 1998, ORNL collected 2,449 tons of coal ash. The ash is sent to a commercial facility in Chattanooga where it is reburned and used to manufacture cement.

- ORNL contracted with Safety-Kleen to service photographic equipment. Recoverable material shipped off-site included 1997 and 1998 silver waste generation. The initial shipment contained 23.5 pounds of silver flake, 21 de-silvering cartridges and 1,400 pounds of photographic film, all which had been accumulated in 1997 and 1998. The subsequent shipment contained only four pounds of flake and 20 cartridges. Revenues from the silver offset the cost of having the photographic equipment serviced with new de-silvering cartridges.

- During dismantling of the Engineering Technology Division (ETD) Alkali Metal Facility, 180,000 pounds of scrap metal were salvaged for melt and five tons of sodium were sold back to DuPont, the original material vendor.

- The Sludges Removal Project team recycled copper cables.

- Other quantities recycled:
  - 3,437 toner cartridges
  - 574 pounds of plastic laboratory waste
  - 4.3 tons of aluminum cans
  - 95.4 tons of mixed paper
  - 158.3 tons of white paper
  - 112.2 tons of corrugated cardboard
  - 2200 gallons of motor oil

Reuse

- Five 55-gallon drums of an existing depleted uranium waste solution from East Tennessee Technology Park were re-used to denature old Hydrofracture Tanks.

- The Sludges Removal Project team prevented the generation of approximately 5,000 gallons of highly contaminated wastewater by balancing and reusing supernate (X175).

- Three tons of stainless steel and 30 tons of concrete were reused on site. Contract revenue of $14,090 was returned to the government.

- Radioactive equipment was decontaminated and sent to salvage.

- The High Ranking Facilities Deactivation Project conducted radiological surveys to segregate free-releasable items from activated and contaminated items. After the survey, 515 tons of material were found to be releasable. Thirty tons of concrete and three tons of stainless steel were reused on site.

- ORNL launched an Office Supplies Recycling Program. This involved establishing a location for employees to send office supplies they no longer need. Employees are encouraged to check with this site before ordering new supplies.

Waste Minimization

- ORNL obtained a new mercury analyzer that produces 50 percent less waste and requires 50 percent less operating time.

- The Gunite and Associate Tank Project mixed supernate with grout and transferred tank supernate into tanks with sludges to avoid generating 300,000 gallons of liquid LLW, and The team also used reusable personal protective equipment (PPE) during the project to avoid 385 cubic feet of PPE waste.

- The Pollution Prevention High Investment Value (HIVal) Program awarded funding to three ORNL projects costing $147,000 with a projected annual return of $224,000. The three projects are Utilization of Non-Lead Ammunition at Oak Ridge's Central Training Facility, Burner and Ventilation Upgrade for the ORNL Lead Shop, and Oil Free Vacuum Pumps for Physics.

- The garage acquired purifier filters to remove water and particulates from truck oil, allowing it to be cleaned and reused an estimated four times before it is recycled off-site.

- Several glove boxes in the Transuranic Research Laboratory now use oil diffusion pumps, which generate less contaminated oil and cooling water.

- ORNL replaced three oil-lubricated vacuum pumps on TRU-contaminated glove boxes with dry pumps, completely eliminating the generation of 20 liters per year of TRU contaminated oil and potential personnel exposures.

- ORNL replaced the water-cooled-oil lubricated pumps on a mass spectrometer and other experimental apparatus with turbo -drag and dry -scroll pumps. The mass spectrometer is used to study laser-vaporization of transuranic elements and is therefore considered to be TRU contaminated. Use of the dry pumps eliminates the possibility of generating TRU/RCRA mixed wastes, and reduces the generation of contaminated oil and cooling process water.

Pacific Northwest National Laboratory (PNNL)

PNNL conducted 45 pollution prevention projects in 1998, which reduced waste by **14,113 metric tons** for estimated savings and cost avoidance of **$804,870**. Examples of specific projects include:

Recycling

- The Molecular Biosciences Department uses a mixture of methanol, acetic acid, and Coomassie blue dye as a stain to detect proteins. The dye was stripped out using activated carbon and the destaining solution was then reused, avoiding disposal and purchasing costs.
- Formalin, alcohol, xylene, and methanol are distilled and reused.
- Lead was recycled on-site through the fabrication shop and off-site through a recycler.
- One full 55-gallon barrel of outdated boiler treatment chemicals was recycled back to the manufacturer/supplier through a contractual agreement.
- PNNL inherited an underground tank system from a previous owner of one of its buildings. The tanks were contaminated with minute amounts of radioactive material and metals on the toxicity characteristic list. Rather than disposing of the tanks as waste, they were recycled as radioactive scrap metal to GTS Duratek in Oak Ridge, TN for later use at the Los Alamos National Laboratory.
- A propylene glycol/water mixture was recycled on site.
- Approximately 160 gallons of expired water treatment chemicals and test kits were returned to a local chemical company representative for recycling.
- The PNNL locksmith has sent thousands of old keys to an off-site recycler.
- Obsolete software and software documentation were sent to a recycler. The recycler degausses and reformats the diskettes for resale and recycles the scrap paper from the packaging and documentation.
- Over 20,000 plastic pipette tip racks were returned to the supplier for recycling.
- Janitors collected and recycled aluminum cans, and retained the funds for their efforts.
- An oil separator and underground tank were recycled preventing the generation of 1,970 pounds of sanitary waste.
- In CY98, the Office Paper Recycling Program recycled 173 metric tons of mixed paper, 0.44 metric tons of glass, 0.27 metric tons of tin, and 0.19 metric tons of plastic.
- Transparencies used for overhead projection were recycled offsite through the 3-M™ Recycle Program. The transparencies are melted and remanufactured into new transparency film, automotive products, insulation, and carpets.

- In CY98, 2,071 toner cartridges were sent offsite for recycling. Remanufactured cartridges were purchased through a preferred-customer contract.

Reuse

- The Chemical Redistribution Center collects and redistributes excess chemicals throughout the Laboratory. A total of 14 kg of chemicals were redistributed.
- Thirty-six drums that would have been disposed as hazardous waste were returned to chemical vendors.
- Twenty-six pounds of lead sheeting left over from a research experiment were sent to the Laboratory's fabrication shop for reuse.
- As part of the Canyon Disposition Project, a robot was needed to assist with the characterization of U-Plant. A robot was saved from disposal at the 325 building and reused for this project. It is hoped that the robot can be reused at least twice more on similar projects.
- A number of office supplies were reused through the initiatives of staff at the Laboratory.
- More than 60 3-ring binders were saved from the landfill and then advertised and redistributed for reuse at the Laboratory.
- More than 6,500 folders and 9000 pounds of paper were donated to local schools for reuse.
- Saturated filters used for water treatment were regenerated and reused.
- The Consolidated Information Center Library frequently receives software diskettes to update their databases and programs housed on the Internet. Instead of sending approximately 250 diskettes per year to the software recycling program, they were made available to staff, students, and the general public, free of cost.

Waste Minimization

- The urgent need for geochemical research occasionally forced the analysis of non-radioactive samples on the ion chromatograph system dedicated for radio-labeled samples. Purchase of an autosampler for the existing "cold" ion chromatograph kept the radioactive and non-radioactive waste streams separate and allowed the "cold" sample waste to be disposed to the sanitary sewer.
- The stockroom at the Environmental Molecular Sciences Laboratory maintained a supply of 140 rechargeable alkaline and nickel-cadmium batteries that it exchanged for any single-use battery or for depleted rechargeable batteries. As demand increases, more rechargeable batteries will be purchased.
- As part of a research project for the United States Department of Transportation, gasoline is vaporized and recondensed back to liquid. When small quantities were generated, 23 gallons of the recondensed gasoline were recycled through the Maintenance Services organization for use in groundskeeping equipment. When it became clear that much larger quantities of gas would be

generated (250 gallons), the project changed their process to reuse gasoline within the research project.

- Microorganisms are studied for their ability to reduce various metal ions during processes such as the environmental remediation of groundwater. These studies involve colorimetric metal ion analyses and direct counting of fluorescently-stained bacteria. The purchase of a microplate reader reduced the volume of waste generated by a factor of 10. In addition, the microplate reader automated the counting process during fluorimetry analyses, greatly reducing labor.

- PNNL staff formerly used 60-watt incandescent bulbs in the corridors as warning lights when lasers were in use. Because of a high failure rate and safety needs, the bulbs were replaced quarterly whether they worked or not. Staff replaced the incandescent bulbs with 1.8-watt light-emitting diode modules, which will pay for themselves in 1.5 years.

- Previously, during larval toxicity testing, formaldehyde was used as a fixative for preserving physical features. Lugol's solution was identified as a viable substitute for formaldehyde during bivalve larval tests, reducing the generation of hazardous wastes at this laboratory by 80 percent for larval tests and reducing employee exposure to formaldehyde, classified as a carcinogen.

- Previously, synthetic deoxyribonucleic acid and proteins were purified by reverse-phase chromatography using solutions that contained acetonitrile. New gel filtration and ion exchange columns that use nonhazardous solutions were installed. The new size exclusion chromatography method eliminates 300 liters of hazardous waste per year.

- The conventional method for the nebulization of acid solutions for inductively coupled plasma/optical emission spectroscopy analysis results in an uptake of approximately 2.5 ml/min, only 3-5 percent of which is actually used for analysis. The remainder is disposed as hazardous waste. A high efficiency nebulizer was purchased and installed that reduces the generation of waste by 20 times.

- PNNL purchased a closed-circuit digital camera for the metallograph microscope, eliminating development and printing of micrographs with hazardous chemicals.

- The Molecular Biosciences Department at PNNL purchased a Lumi-Imager workstation, a computer imaging system that allows the detection of chemiluminescent signals. The Lumi-Imager eliminates the use of X-ray film and chemicals for developing the film, which reduces hazardous and sanitary waste and saves more than $3,000 in dark room space, $10,000 in chemical supplies, and $55,000 in labor.

- PNNL had a resource library of photographs, which it scanned and placed on the Laboratory's Intranet for easy access and use by staff. This home page, known as DigiSource, has eliminated the photo chemicals required to develop approximately 100 photos per month.

- Several different microdigestion methods were tested for use with inductively coupled plasma/mass spectroscopy metals analysis and cold vapor atomic absorption mercury analysis. Previously, 0.5 g of solid material were digested in 5 to 10 ml of concentrated acid and then diluted to 20 ml of solution. After metals analysis, 18 ml per digestion were left for disposal as hazardous waste. It was found that microdigestion works for most metals and reduces waste by approximately 90 percent.

- A polymer absorption product, Quick-Solid, was pilot-tested to replace kitty litter as an oil absorbent. The new product greatly reduced the volume of waste generated.

- Previously, Inductively Coupled Plasma Mass Spectrometer analysis of radioactive material required a volume of 5-10 milliliters (ml) of sample that was aspirated at a rate of ~1 ml/minute for analysis. Much of this waste was eliminated with the purchase of a microconcentric nebulizer that aspirates samples at a rate of only ~0.1 ml/minute, while affording the same or better instrument sensitivity as the standard nebulizer. Benefits include a reduction in analysis waste, unused sample waste, and a reduction in worker exposure. Fifty liters MLLW and 20 kilograms LLW were avoided per year.

- Samples from the Hanford waste tanks are analyzed for chelators using High Performance Liquid Chromatography (HPLC). The use of smaller columns reduces both the analytical time and flow rate. It is estimated that the new columns reduce mixed LLW from 40 liters per year to four liters or less per year.

- A solid-waste forecasting report was revised so that both data collection and reporting were done electronically, eliminating the distribution of 60 data collection forms and 75 copies of a 300-page final report.

- Improvements were implemented which allow several stages of the recruiting process to be done electronically: 1) External resumes can now be submitted electronically through the PNNL web page, 2) The job application was reduced by 8 pages, and 3) Electronic mailboxes were established for the collection and transmittal of internal resumes.

- Maintenance of the cooling water ponds at the Research Operations Building and the Life Sciences Laboratory-II building requires that the pond water be periodically drained to clean debris from the bottom of the pond. Previously, the water from both ponds was drained at the same time and then each cleaned. PNNL changed the procedure to drain water from only one pond at a time. After one pond was cleaned, water from the other pond was transferred to it and the second pond was then cleaned and filled. The new procedure resulted in only 500,000 gallons of water being sent to the process sewer.

- A cooling system was reconfigured for several electron microscopes located in the 320 building. The installation of a new closed-loop piping system eliminated the use of single-pass, non-contact cooling water, saving over three million gallons of cooling water.

Princeton Plasma Physics Laboratory (PPPL)

PPPL conducted 16 pollution prevention projects in 1998, which reduced waste by **192 cubic meters** for estimated savings and cost avoidance of **$93, 792**. Examples of specific projects include:

Recycling

- Fifteen cubic yards of oil-contaminated soil were placed in lined roll-off boxes for recycling at an asphalt paving plant.
- Batteries, including lead acid batteries from building emergency lighting systems, nickel-cadmium batteries, and alkaline batteries, were routinely recycled.
- Crushed fluorescent T12 lamps with a concentration of > 0.2 mg/l were routinely recycled.
- Electronic and computer scrap, aluminum, cardboard, concrete, paper, wood, and scrap metal were routinely recycled.
- System Service International Inc. took 1,775 pounds of magnetic tapes for recycling.
- PPPL recycled approximately 500 phone books during the first quarter of CY98. Each phone book weighs 3.9 pounds, preventing an estimated 0.886 metric tons from being disposed in a sanitary landfill.
- A commercial recycler purchased 1,380 pounds of Freon-11 through the excess property sales operations of the Material Control Division.
- Office products, including 218 toner cartridges, were returned for recycling rather than disposed of as waste.

Reuse

- Boron Frit, a concrete additive, was reused in the Decontamination & Decommissioning effort for Tokamak Fusion Test Reactor at PPPL.
- PPPL reused crushed glass scintillation vials as void space filler in the shipment of LLW, savings the cost of purchasing void space filler at a cost of 194 $/m3.

Waste Minimization

- PPPL began replaced 456 of its T12 fluorescent lamps that have more than 0.2 mg/l mercury fluorescent lamps with T8 ALTO or ECOLOGIC lamps that have less than 0.2 mg/l of mercury.

Stanford Linear Accelerator Facility (SLAC)

SLAC conducted more than five pollution prevention projects in 1998, which reduced waste by **570 metric tons** for estimated savings and cost avoidance in excess of **$100,000**. Examples of specific projects include:

Recycling

- Non-radioactive lead metal was smelted off-site in 1998 to produce new shielding.

Reuse

- SLAC reused approximately 200 non-radioactive concrete rafts (about 1,000 tons total) that had once been used to support the PEP magnets. Approximately 80 of the rafts were reused to construct the Interaction Region halls for the new PEP-II Project. The others were used on-site as retaining walls or were given to Menlo Park Fire Protection District's training center for use in practicing rescue missions.
- Approximately 20 tons of potential hazardous waste was avoided by sending materials back to to the manufacturer to a new user, resulting in savings of over $60,000.

Waste Minimization

- SLAC reused spent alkali and acid baths as treatment chemicals in the Rinse Water Treatment Plant to adjust pH and remove heavy metals. This reuse reduced waste disposal volume by 5,000 gallons per year and saved approximately $40,000 in waste disposal costs.

- The Metal Finishing Shop reduced its use of plating bath filters by more closely monitoring pressure drops across the filters. The resulting reduction in filter usage, procurement, replacement and disposal costs saved $2,300.